KNOWLEDGE
AN ILLUSTRATED
MAGAZINE OF SCIENCE
PLAINLY WORDED—EXACTLY DESCRIBED

LONDON: FRIDAY, FEBRUARY 24, 1882.

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OUR ANCESTORS.

I.—THE STONE AGE MEN.

By Grant Allen.

THERE are few questions more immediately interesting to Englishmen than the question—who are our ancestors? From what elements and in what proportions are we compounded? May we consider ourselves as all pure Teutons? or are we partly Celts as well? Furthermore, may we even reckon among our immediate ancestry some still earlier and less historical races than either of these? Such questions are full of practical importance to ourselves, and they are also of a sort upon which modern investigations into language and the science of man have cast a strikingly new and unexpected light.

Of course, in considering the origin of Englishmen, we must look at the matter in no petty provincial spirit. We must include roughly in that general name Welshmen, Scotchmen, and Irishmen as well; and if our friends in the north prefer to speak of Britain rather than of England, I am sure I, for my part, will have no objection. There are many learned modern historians, with Mr. Freeman at their head, who will tell us that Englishmen are almost pure-blooded Teutons, of the same original stock as the Germans, the Dutch, and the Danes and Norwegians. But when we come to inquire more fully into their meaning, it turns out that they are speaking only of the native inhabitants of England proper and the Scotch Lowlands, without taking into consideration at all the people of Wales, Ireland, and the Highlands, or the numerous descendants of immigrants from those districts into the south-eastern half of Great Britain. Even in the restricted England itself, these same doughty Teutonic advocates admit that there is a nearly pure Celtic (or pre-Celtic) population in Cornwall, in Cumberland, and in Westmoreland; while the western half of the Lowlands, from Glasgow to the border, is also allowed to be inhabited by a mainly Welsh race. Furthermore, it is pretty generally granted by our stoutest Teutonic champions themselves, that the people of Dorset, Somerset, and Devon, of Lancashire, Cheshire, Shropshire, Herefordshire, and Worcestershire, are all largely mingled with Celtic blood. Thus, in the end, it appears that only the native inhabitants of the Lothians and the Eastern and Southern coast of England are claimed as pure Teutons, even by those who most loudly assert the essentially Teutonic origin of the English people. We may possibly find that this little Teutonic belt or border itself is not without a fair sprinkling of earlier blood.

Perhaps the best way to clear up this question will be to glance briefly at the various races which have inhabited these islands, one after another, and then to inquire how far their descendants still exist in our midst, how large a proportion of our blood they have contributed, and whereabouts their representatives are now mainly to be found. Of course, in such an inquiry we can only arrive at very approximate results, for in our present advanced stage of intermixture, it is almost impossible for any man to say exactly what are the proportions of various races, even in his own person. Each of us is descended from two parents, four grand-parents, eight great-grand-parents, and so forth; so that, unless we could hunt up our pedigrees in every direction for ten generations, involving a knowledge of no less than 1,024 different persons at the tenth stage backward, we could not even say how far we ourselves were descended from Irish, Scotch, Welsh, or English ancestors respectively. As a matter of fact, everyone of us is now, probably, a very mixed product indeed of Teutonic, Celtic, and still earlier elements, which we cannot practically unravel; and, perhaps, all we can really do is to point out that here one kind of blood is predominant, there another, and yonder again a third.

The men of the very earliest race that ever lived in England are probably not in any sense our ancestors. They were those black-fellows of the palæolithic or older stone age, whose flint implements and other remains we find buried in the loose earth of the river-drift or under the concreted floors of caves, and who dwelt in Britain while it was yet a part of the mainland, with a cold climate like that of modern Siberia. These people seem to have lived before and between the recurrent cold cycles of the great glacial period; and they were probably all swept away by the last of those long chilly spells, when almost the whole of England was covered by a vast sheet of glaciers, like Greenland in our own time. Since their days, Britain has been submerged beneath several hundred feet of sea, raised again, joined to the continent, and once more finally separated from it by the English Channel and the Straits of Dover. Meanwhile, our own original ancestors—the people from whom by long modification we ourselves are at last descended—were probably living away in the warmer south, and there developing the higher physical and intellectual powers by which they were ultimately enabled to overrun the whole northern part of the old world. Accordingly, interesting as these older stone age savages undoubtedly are — low-browed, fierce-jawed, crouching creatures, inferior even to the existing Australians or Andaman Islanders—they have yet no proper place in a pedigree of the modern English people. They were the aboriginal inhabitants of Britain; but their blood is probably quite unrepresented among the Englishmen of the present day.

Long after these black-fellows, however, and long after the glaciers of the ice age had cleared off the face of the country, a second race occupied Britain, some of whose descendants almost undoubtedly exist in our midst at the present day. These were the neolithic, or later stone-age men, who have been identified, with great probability, as a

branch of the same isolated Basque or Euskarian race which now lives among the valleys of the Western Pyrenees and the Asturias mountains. They seem to have crossed over into Britain while it was still connected with the Continent by a broad isthmus, or, perhaps, even by a long stretch of land occupying the entire beds of the Channel and the German Ocean. Our knowledge of them is mainly derived from their tombs or barrows—great heaps of earth which they piled up above the bodies of their dead chieftains. From these have been taken their skeletons, their weapons, their domestic utensils, and their ornaments, all the latter objects having been buried with the corpse, for the use of the ghost in the other world. From an examination of these remains, we are able largely to reconstruct the life of the Euskarian people—the earliest inhabitants of Britain whose blood is still largely represented in the existing population.

In stature, the neolithic men were short and thick-set, not often exceeding five feet four inches. In complexion, they were probably white, but swarthy, like the darkest Italians and Spaniards, or even the Moors. Their skulls were very long and narrow; and they form the best distinguishing mark of the race, as well as the best test of its survival at the present day. The neoliths were unacquainted with the use of metal, but they employed weapons and implements of stone, not rudely chipped, like those of the older stone age, but carefully ground and polished. They made pottery, too, and wove cloth; they domesticated pigs and cattle; and they cultivated coarse cereals in the little plots which they cleared out of the forest with their stone hatchets or tomahawks. In general culture, they were about at the same level as the more advanced Polynesian tribes, when they first came into contact with European civilisation. The barrows which they raised over their dead chieftains were long and rather narrow, not round, like those of the later Celtic conquerors. They appear to have lived for the most part in little stockaded villages, each occupying a small clearing in the river valleys, and ruled over by a single chief: and the barrows usually cap the summit of the boundary hills which overlook the little dales. Inside them are long chambered galleries of large, rough-hewn stones; and when these primitive erections are laid bare by the decay or removal of the barrow, they form the so-called "Druidical monuments" of old-fashioned antiquaries, a few of which are Celtic, but the greater part Euskarian.

At some future period I hope to lay before the readers of Knowledge a fuller account of these neolithic people and their existing remains. At present, the points to which I wish to call attention are, firstly, the fact of their existence in early days in Britain; and, secondly, the fact that many of their descendants still remain among us to the present day. Nor do I propose in this paper to estimate the numerical strength of the Euskarian element in the population of the British islands as it now stands. It will be best to consider that part of the question at a later point in this series, when we have seen what were the subsequent races which overcame, and in part displaced, the aboriginal Euskarian folk. For the moment, it will suffice to point out that before the arrival of the Celts and other Aryan tribes in Britain, these Euskarians spread over the whole of our islands, and were apparently the only people then inhabiting them. At least, the monuments of this date—perhaps from 5,000 to 20,000 years old—seem to be similar in type wherever they occur in Britain, and to contain the remains of an essentially identical race. I shall also add here, by anticipation, what I hope to show more in detail hereafter, that their descendants exist almost unmixed at the present day as the so-called Black Celts in certain parts of Western Ireland and Scotland, and in a few places in South Wales; while their blood may be still traced in a more mixed condition in Yorkshire, Lincolnshire, East Anglia, the Scotch Highlands, and many other districts of England and Scotland. How they have managed to survive and to outlive the various later Celtic and Teutonic conquests, we shall have to inquire when we come to consider the origin and progress of those subsequent waves of population.

BIRTH OF THE MOON

By Tidal Evolution.

By Dr. Ball, Astronomer-Royal for Ireland.

PART II.

UP to the present point, dynamics have guided us with unfailing accuracy, but if we attempt to look back still earlier, we have not the sure light of dynamics for our guide. Yet it is impossible to resist a speculation as to how the moon and the earth came into this wondrous relation. Mr. Darwin has made the suggestion that most probably the moon was actually fractured off from the earth. This is indeed a romantic origin for the moon, but listen to the grounds by which it may be substantiated. In those early days, before we believed the moon existed, the sun raised tides on the earth as he does at present. It was, no doubt, the case that the earth had then no oceans of water on its surface. The tides were manifested by actual throbs in the soft or molten materials of the earth itself. Twice a day the earth rose and fell under the pulses of the solar tides, but as the day was then only three hours, the interval between one high tide and the next was but an hour and a half. The earth was thus in a state of vibration in consequence of the solar tides. These solar tides were, no doubt, small, as the solar tides are small at the present day. But at that very remote epoch it seems not unlikely that there was a particular circumstance which was calculated to exaggerate erroneously the influence of the solar tide. The point now referred to is not an easy one to explain; let me try to simplify it by an illustration. A heavy weight is hanging by a string—say, for example, a weight of 14 lb. is suspended by a string a yard long, with a light wooden mallet weighing an ounce or less; you give the weight a series of blows—generally speaking you will not succeed in giving to the weight any large degree of swing, but if you carefully time the blows so that they shall harmonize with the natural swing of the weight, you will find it quite easy in a short time to give to the large weight as great a swing as you may desire. Your success has depended upon the fact that the impulses were timed to harmonize with the natural vibrations of the weight. In a similar manner, the semi-molten mass of the earth had a period of vibration. Impulses small in themselves which did not harmonize with that period could produce but a trifling effect. It has, however, been shown that the natural period of the vibrations of the molten earth must probably have been about an hour and a half. This, it will be remembered, is also the period of the solar tides. Here, then, we see how the solar tides in that early epoch may have risen to transcendent importance. It is also very significant that a period of rotation equal to three hours is very close to the most rapid rotation which the earth could have possessed without actually falling in pieces. Here, then, we have all the elements necessary for a rupture. The earth is on the point of breaking by its rotation, then the solar tides come into action, each tide augments the effect of the previous tides, until at length the earth, dis-

tracted by tremendous oscillations, has broken off a mighty fragment. That fragment formed the moon.

The date of this occurrence (or, to speak more precisely, the date when we find the moon to have been placed as if this occurrence had happened) we cannot tell. It is certain that it must have been more than fifty million years ago—it is probably very much more. The subsequent history of the moon can be traced with comparative certainty. It appears that the critical condition in which the moon was, close to the earth and rapidly rotating around the earth in a period equal to the day, could not last. The case is one of unstable equilibrium; either the moon must fall back again into the earth, or else it must begin to move outwards from the earth. The fact that the moon exists shows that the latter alternative was adopted, though it does not seem quite clear why that course rather than the other should have been chosen. As the moon receded, the duration of the month increased, its duration at any distance being determined by Kepler's laws. The month has increased steadily from its primitive value of three hours, up to the present time, when the month is over 27 days.

This alteration in the length of the month has entailed a corresponding alteration in the length of the day. As the distance of the moon increased, so the length of the day increased from the primitive three hours up to the present 24 hours. The ratio between the day and the month has, however, altered in a manner which must receive careful attention, as it involves consequences of the very deepest interest. In the primitive state of things, the day and the month were equal; but when they both began to lengthen, the month increased much more rapidly than the day. Of course, it will be understood that we are here speaking of the changes in the ratio of the length of the month to the length of the day at the same epoch. The month gradually became twice the day, it became three times the day, and the ratio gradually increased until the time came when the month was twenty-nine times the day. This time has but lately passed, the ratio of the month to the day was then at its maximum, and the decline has now commenced. After the month was twenty-nine times the day, the ratio gradually sank until the length of the month was twenty-seven times that of the day. This is an epoch of the most special interest—it is the present time.

The tides have thus guided us in tracing the earth-moon history from the beginning, when the moon was first cast off, down to our own days. Nor will the tides now desert us—they will enable us to make a forecast of the distant future. The day will continue to lengthen, the moon will continue to recede, the month will get longer (measured by hours), but the day will lengthen more rapidly than the month. Instead of the month being 27 days, it will in time to come be only 26 days, only 25 days, and at some enormously distant epoch the final state of things will have been reached, and the day and the month will be again equal. The first stage of this history and the last stage are in one sense identical. In each case, the day is equal to the month. In the first case, the day and the month are each three hours; in the last case, the day and the month will each have lengthened to the enormous extent of 1,400 hours. The 1,400 hours is no doubt more or less doubtful, but we are assured by the laws of dynamics that there is some magnitude of that kind to which both day and month are tending, and to which they will both ultimately become equal. In another way, also, the first stage of the earth-moon history and the final stage may be compared. The earth turned the same face constantly towards the moon at the beginning. The earth will turn the same face constantly towards the moon at the end.

FALLACIES ABOUT LUCK.

By the Editor.

As to fallacies about luck, the supposition that after a great number of heads in fifty tossings, the next fifty would probably show a smaller number, involves precisely the same error (diluted by being spread over a larger space, but not diminished in amount) that I dealt with in my former paper. How can the number of heads in one set of fifty tossings affect the number which shall appear in the next? Science says on *à priori* grounds, "not at all"; Experiment repeats as emphatically (it could not say so more emphatically) "not at all." But then, says the querist, how is it that, as science assures us, there is always in the long run an approach to equality in the number of heads and tails tossed in a great number of trials? If the balance always tends to the horizontal position, surely a movement of one scale upwards should assure us that presently the other scale will begin to rise. Equality is indeed brought about in the long run, but not in the way imagined. Absolutely not the slightest influence is produced on the results of one set of, say, a hundred tossings, by the observed results of the next preceding set: (how *could* there be?). Nor is there any tendency in a very long series of tossings, starting from some particular point, to reduce a discrepancy between heads and tails, which had attained any amount up to that point. On the contrary, if we count from and after that point, as well as if we count from and after the absolute beginning, we shall find the same tendency to equality in the results of a great number of tossings. The excess of heads over tails, or of tails over heads, may go on increasing, and yet there is the tendency to equality which science indicates. This sounds paradoxical, but it is what science teaches and what experience confirms. It is demonstrable that the greater the number of trials of coin tossing, the nearer will the *ratio* of heads to tails approach to equality, though the actual excess of one over the other may probably be greater, and possibly much greater, than in a smaller number of trials.

Take a very simple case. Suppose a coin tossed four times, and consider the chance that there will be either two more heads than tails, or two more tails than heads. There are in all 2^4, or 16 possible events. That there may be two more heads than tails, three heads must be tossed, which can happen manifestly in four different ways, for the first, second, third, or fourth toss may give the single tail. So, also, there may be two more heads than tails in four different ways. There are therefore 8 ways (out of 16) in which either heads or tails may show three times as against one of the other kind. The chance is therefore $\frac{1}{2}$, or it is an even chance, that there will be this degree of discrepancy. On the other hand, there are only 6 ways in which there can be 2 heads and 2 tails, for only 6 pairs can be made out of 4 (the first tossing may be head, as also second, third, or fourth; the second may be head, as also third or fourth; the third may be head, as also the fourth; and these arrangements of 2 heads give also all the arrangements of two tails). Thus the chance of absolute equality is only 6-16ths, or 3-8ths, that is, the odds are 5 to 8 against absolute equality, while the chance that there will be a difference of 2 exactly between the heads and the tails is $\frac{1}{4}$. (The chance that all 4 will be of the same kind is, of course, 1-8th.)

Now compare with this the results we get when, instead of 4, there are 8, tossings. Here there are 2^8, or 256 possible events, and it can readily be shown (but I leave this and the general problem to a series of papers which I shall hereafter write on probabilities) that the chances of

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the different results, and the odds respecting them, are as follows :—

	Chance.	Odds.
All heads or all tails	1-128th	... 127 to 1 against.
All but 1, heads, or tails ...	1- 16th	... 15 to 1 against.
All but 2, heads, or tails ...	7- 32nds	... 25 to 7 against.
All but 3, heads, or tails ...	7- 16ths	... 9 to 7 against.
Four heads and four tails ...	35-128ths	... 93 to 35 against.

The most probable of all events in this case, as in the last, is that there will be 2 more heads than tails, or *vice versâ*; and whereas in the former case it was an even chance that there would be just this discrepancy, the odds in the present case are 9 to 7 against it. But the chance that there will be this discrepancy *at least* is greater with the greater number of trials. For in the former case the odds were but 5 to 3, or 175 to 105, against absolute equality, in the present case they are 93 to 35, or 279 to 105 against it. And it can be shown that it becomes less and less likely the greater the (even) number of tossings, that there will be absolute equality. Yet, on the other hand, in the cases considered, the chance that heads will exceed tails, or tails heads, not by a given amount, but in a given degree, diminishes as the number of tossings is increased. Thus with 4 tossings, the chance that heads will be to tails as 3 to 1 (or *vice versâ*) is, as we have seen, one half; with 8 tossings the chance of this relation holding (6 of one kind, two of the other) is only 7-32nds. Again, the chance that heads will be to tails, or *vice versâ*, in a ratio of not less than 3 to 1 is 5-8ths in the former case; in the latter (adding together 1-128th, 1-16th, and 7-32nds), we find it to be only 37-128ths; in one case the odds are 5 to 3 in favour of that amount of discrepancy at least, in the other they are 91 to 37 against there being a discrepancy so great.

But some correspondents ask whether, even in matters of pure chance, there may not be something more than mere accident,—whether some men may not have a certain degree of good fortune given to them,—whether, in fine, what is called luck may not in some degree depend on Providence. This takes us a little outside the domain of science; but as it does not bring us upon any of the vexed questions of dogmatic religion, I will venture to make a remark or two on this (in reality) unscientific aspect of the question. To the student of science it appears as absurd to imagine that the laws of nature would be set on one side in matters of pure chance (for even in coin tossing nothing short of a miracle can cause the law of averages to be departed from—in the long run—either in favour of any one or against him) as it would be to conceive that an experimenter favoured by Providence might get a mixture of carbonic acid gas* and nitrogen to behave like a mixture of oxygen and hydrogen, or as it would be to suppose that during Darwin's researches into the work of earth-worms, these creatures, *suadente diabolo*, acted in a way not natural to their kind. If in the case of so-called lucky gamblers, a supernatural power, good, bad, or indifferent, has been at work, science has no power of dealing with the phenomena. All science can say is, that the observed and recorded phenomena agree precisely with those which can be shown to be necessary consequences of the laws of probabilities: all she can do is to go on dealing with the matter precisely as a Pasteur would go on dealing with the observed phenomena of disease germs, uninfluenced by any suggestions that diseases were produced by supernatural agencies.

* I am perfectly aware that what was called carbonic acid gas twenty years ago now goes by another name; and I am equally aware that a technical meaning is given to the word "mixture" other than its ordinary significance. But I am not addressing chemists just now.

So far, I have simply considered what science necessarily does in such cases. The student of science can do no otherwise. But I may note, in passing, that just as there seems to be something irreverent in the suggestion of Providence arranging for the "breaking of the bank" by a Garcia or any other unprincipled gambler, so the general suggestion that Providence, and not the laws which have been assigned to the universe (how or why we know not), is to be credited or discredited with all the chances or coincidences which seem surprising to us, appears to me singularly dangerous to the faith of the weaker minded. Because, while many of these coincidences have been satisfactory enough in their results, at least as many have been very much the reverse, and not a few utterly deplorable.

Take for instance the following case :—

In the winter and early spring of 1881, in America, railway accidents were very common (231 happened in the first two months of that year), and any one who had (as I had) much railway travelling to do at that time had a very fair chance of coming in for wounds and contusions, if not worse.* Now it so chances that at the end of February, a train was wrecked in Missouri, in which two persons were killed and many injured. Another train was sent, carrying several medical men, and a number of appliances for the relief of the wounded. By a most unfortunate chance, this train, thus forwarded to help many suffering persons, was itself wrecked; seven persons were killed, including several of the doctors. If we are not to consider this strange and sad coincidence as belonging to the chapter of accidents, as due to the chances which always affect events depending on natural causes (as the weakening of embankments by frost and thaw, the action of winds, rain, snow-drifts, &c.), must we regard it as due to special intervention of Providence? Science tells us, and experience confirms her teaching, that in the game man plays (or his contest, if you will) with nature, the laws of nature are as laws of the Medes and Persians, that he must not expect to have his moves back, or any help outside the laws assigned (inexplicably so far as we are concerned) to nature: if he does expect this, he will most assuredly be disappointed.

THE CRYSTAL PALACE ELECTRICAL EXHIBITION.

Third Notice.

THE most casual observer can discern some improvement during the past week, although there still remains a great deal to be done before anything like completeness can be said to be attained. Some of the exhibits exist only in the catalogue, and it seems apparent that no attempt will be made to proceed any further than a display of advertisements. It has occurred to us that some

* For my own part, I thought it exceedingly likely that before the lecture season came to an end, my lecturing might be interrupted. As week passed after week without an accident, I neither judged that the next journey was more likely or that it was less likely to be disastrous. At last, towards the end of February, my turn came. The train I was in was pitched over an embankment, not far from Richmond, Missouri, falling some twenty or thirty feet, and a stove drove its way through a stout plank within two inches of the place where my head lay. Was I lucky or unlucky? unlucky in going by that particular train; or, being in it, lucky in escaping with no injuries worse than a nearly fractured skull and a nearly broken leg. As I and the other passengers looked at the shattered interior of the car, we thought ourselves lucky to be alive; as we considered the various damages which our persons and property had sustained, we took a different view. (The accident turned out afterwards to have been singularly fortunate for me, but that is a detail.)

advantage would be gained by the directors prohibiting the fixing of any advertisements whatever, until the exhibits they refer to are duly placed in position, or something approaching thereto. The most notable advances are in electric lighting. The Brush Company, to which reference was made last week, have got all their five engines *in situ*, and three of them running.

The visit of the Lord Mayor two or three weeks since has caused considerable delay in the general preparations, some of the now unprepared firms having had (in order to contribute towards making a display suitable to the occasion), to start their engines before the concrete foundations had dried; consequently, these foundations were pulled to pieces and had to be re-laid. In the Italian Court is one of the prettiest exhibits conceivable. It consists of a brass chandelier of delicately chaste design, decked with forty-two incandescent lamps of the British Electric Light Company. They are very regular, and appear to have been carefully selected. Although the light from them thoroughly illuminates the court, still greater effect is to be produced, as the Company is at present using only one 8-horse-power engine to maintain seven Brockie (arc) lamps, in addition to the forty-two incandescent lamps. When all is in working order, there will be two more engines at work, each of 16-horse-power.

Consequent, presumably, upon the serious railway accidents which have so alarmed Londoners lately, great attention is centred on the various exhibits for improving our systems of signalling, &c. In the Eastern Gallery, far away from the general bustle, is a working model of a system invented by Mr. King, of Paixton, Derbyshire, exhibited by the Electric Railway Signal Company. The model illustrates the working of three signal posts controlling a main line and a branch line connected with it. There is a treadle between the rails opposite each signal post and in connection with it. A train in passing over the treadle connected to, say signal-post A, puts that signal, by a mechanical contrivance, to danger—that is to say, the line is automatically blocked to a following train. The signal cannot be lowered until train No. 1 passes signal-post B, in passing which, by pressing on the treadle, it puts post B to danger by mechanical means, and, simultaneously, by completing an electrical circuit, lowers the signal at post A. Train No. 2 is therefore at liberty to pass post A, but cannot pass post B until train No. 1 has passed post C., and so on throughout the line. If the train has to go on to a branch line, the lever operating the points interlocks with the signals, in this case blocking the main line and clearing the branch. These signals can be reversed (that is to say, the main-line signal cleared and the branch line signal blocked) only by altering the lever. It is evident, then, that by this system there cannot be two trains in any one section of the line at the same time, unless the driver of one of the trains ignores or fails to see his signal.

An arrangement is also shown by which a train, in passing a signal box, puts the minute-hand of a clock back to zero. The hand then travels on for fifteen minutes, or until the following train puts it again to zero. In this way, the driver, as well as the signalman, can see how long a time (up to fifteen minutes) has elapsed since the passing of the preceding train. Another arrangement (not shown in the model) is to indicate the number of trains passing during the twenty-four hours, and the time at which each passed. While, however, several high authorities express a wish for a good automatic system, some of the railway officials appear to desire an improved system of hand-signalling. The King patent is readily adaptable to this form, and it is to be hoped that before long we may see such a system as this in general use. The application of this or any other new form must be a process of time, considering the radical change that would be necessary in existing apparatus, and the large outlay involved. Until the system is tried, it is somewhat difficult to form an opinion of its practicability, although to all appearance it is as perfect for clear-weather signalling as can possibly be desired. It does not attempt to overcome the difficulties accompanying foggy weather; and here is apparently its weakest point. In the North Nave, however, is a model of apparatus designed for this purpose, and exhibited by the British and Irish Telephone and Electric Works Company. The model is designed by Mr. Radcliffe, of Birmingham. He makes some use of electricity. Near the signal-post is an electro-magnet (M Fig. 1), over this is a piece of soft iron (A), which, when a current of electricity passes through the electro-magnet, is drawn downwards. When the current ceases, a spring (S) draws A up again.

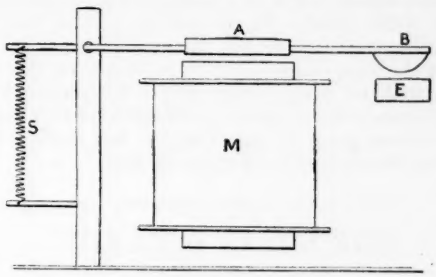

Fig. 1.

Attached to A is a short rod, carrying a block of iron, brass, or any durable substance (B). When the signalman pulls his lever over to drop the signal-arm, the electrical circuit is completed, so that A, and with it, B, are drawn down. Attached to the side of the engine is a lever, or simple rod of iron (represented in section by E), which, if drawn down, acts by means of a spiral spring upon a miniature signal-arm on the driver's platform, within a few inches of his eyes, actuating at the same time his whistle. If the signal is "down" when the engine approaches the magnet, B only touches E, which, in passing under B, simply shakes the miniature arm. If, however, the signal is to "danger," A is drawn down by the current, and B presses the rod E down, and so puts the miniature arm to danger, and by simultaneously blowing the whistle, draws the attention of the driver to the position of the signal and the attention of the signalman to the position of the train.

This, then, if found practicable, is an efficient substitute for fog-signals. It is very simple and ingenious, and it is to be hoped it will prove effective, at least in crowded districts, where the trains, although frequent, do not travel at a very high speed. It is more than possible, we fear, that there may be difficulties in the way of applying the system to fast trains.

Revolution in a Herd of Deer.—For years an old buck, the leader of the deer herd on the Boston Common, has maintained an absolute and malicious tyranny over the younger members of his own sex. His treatment rankled, and the other day, when he shed his horns, they made a combined attack upon him, which only ceased upon the death of the tyrant. The Superintendent and his assistants attempted to interfere, but were driven out of the inclosure by the infuriated animals, which became docile again when their enemy was disposed of. They still preserve, however, a sort of *sic semper tyrannis* air, and thus far, no one of their number has laid claim to the primacy.—*Scientific American.*

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THE RAINBAND.*

EVERYONE who notes a barometer's indications, and carefully compares them with the weather, knows that the barometer is but an unsatisfactory weather guide. There is promise, however, that with an ally apparently insignificant (certainly insignificant in size and expense), we may be able to predict the coming of wet weather with considerable certainty. A pocket spectroscope, directed to any part of the sky, not too near the horizon, will show the presence or absence of the rainband (which Prof. Piazzi Smyth may be said to have discovered, since he first directed attention to its importance);† and so will often tell us of the approach of rainy weather not indicated by the barometer, or that when the barometer points to rainy the weather will in reality be dry. The strength or faintness of this band in the spectrum indicates, in fact, the excess or deficiency of aqueous vapour in the air as compared with the average. With a little practice in the use of one of the rainband spectroscopes advertised in our columns, assisted by study of the little pamphlet before us (which Mr. Browning supplies with his pocket spectroscopes for rainbow study), an Englishman may become so independent of his umbrella, when it is not going to rain, that his best Continental or American friends would not recognise him.

THE GREAT PYRAMID.

By the Editor.

I HAVE prepared two views of the Pyramid regarded as a structure for observation, but as there is great pressure this week on our space, and these views will occupy nearly a full page, it has seemed well to defer that part of my subject to the week after next. I take the opportunity to discuss, as I promised several weeks ago, the curious coincidences which many have regarded as demonstrating what may be called the divine-inspiration theory of the Pyramid.

With the discovery that the base of the Pyramid is several feet shorter than had been supposed, a number of relations supposed to connect the Great Pyramid with astronomy go overboard at a single stroke. I had written a paper showing how singular these relations are, but at the same time how obviously they result from mere coincidence; and now, alas! (another strange coincidence?) the relations themselves disappear, and my remarks upon them have no longer any weight. Still, the coincidences are there. Indeed, it only requires that the Pyramid inch should be slightly altered for the relations to be all once more perfectly fulfilled. What will be done with the arguments showing the true Pyramid inch to be almost exactly the same as the British inch, and the true cubit to be twenty-five of these inches, I do not know: but past experience shows that whatever the precise value of the Pyramid inch, as deduced from these new measures, may prove to be, will be shown to be just the value which corresponds most perfectly with what may be called the Pyramid religion. So, after all, my article may come in well enough. However, I am not so particularly fond of demolishing giants of straw that, when the straw stuffing has been ruthlessly pulled out, I should persist in my attack. So I will here present now very briefly what I had before advanced at some length:—

We find that while the Pyramid fulfils closely the relation which Herodotus says it was intended to fulfil, each slant face being equal in area to the square of the height, it also very nearly fulfils what Taylor tells us was the real purpose of the builder, the height being nearly equal to the radius of a circle having a circumference equal to the perimeter of the square base; and again, it almost as closely fulfils another relation, in having the slant at the edge very nearly as 9 vertically to 10 horizontally. Now, to the ignorant, it seems as though the close approximation of the building's proportions to these three relations, proves demonstrably the mathematical skill of the builders, if not their divine inspiration. As a matter of fact, however, we see from the co-existence of these three relations, any one of which might as well as another be the real one which the builders had in view (were it not certain from what Herodotus tells us, that the first only was their building rule), how easy it is to find such relations if we only look carefully for them, for two out of the three are certainly accidental. So that apart from the evidence of Herodotus, we should be free to reject all three, on the sound plea that since coincidence can so readily be detected, no reliance can be placed upon any argument from *mere* coincidence.

Then, again, according to the measurements just negatived, there were exactly as many cubits of 25 inches in each side as there are days in the year, or 36,524 inches in the circuit of the base. One would have said that if this were really proved, and if the height were determined by any one of the three geometrical rules just indicated, all the dimensions of the Great Pyramid, as a whole, were determined once for all. But even in the early days of the Pyramid religion, the Pyramidalists were not content with this. They found that the two diagonals of the square base together contained as many inches as there are years in the Great Precessional Period, and that the height contained as many inches as there are in the one thousand millionth part of the sun's distance; though, of course, if these relations really hold, they indicate coincidences, and very singular ones too, entirely outside of the Pyramid. As thus: Take one-fourth the number of days in the year, and double the square of this number; the square root of the product equals half the number of years in the Great Precessional Period. And again, take 100 times the number of days in the year, and reduce the number thus obtained in the same ratio that the radius is less than the circumference of a circle; you will then have a number equal to the number of inches which there are in one thousand millionth part of the sun's distance. These two relations exist quite independently of the Pyramid, and, so seen, even Pyramidalists must admit that they are but singular numerical coincidences. They have not a particle of real significance, any more than this one, which I make Pyramidal (by a very transparent device) merely to show how easy it is to work such things:—Take the square base of the Pyramid, and divide each side into as many parts as the Pyramid has faces. Join the corresponding divisions of opposite sides of the base so that the base is divided into sixteen squares. In each of

* "A Plea for the Rainband." By J. Rand Capron.

† Mr. Capron, in mentioning that Prof. Smyth has made himself owner of three parts of the rainband, falls into a somewhat amusing mistake about certain lines which may belong, possibly, to the nursery rhymes of the future, and, therefore, must be carefully guarded from change. He says that in university rhymes, Mr. Lockyer is said to have "made himself owner of half the corona;" whereas, in the original rhymes, written along with many others during the eclipse expedition of 1870—at which time Mr. Lockyer supposed the now abandoned theory of the corona to be unquestionably sound—the words were, "'Of the solar corona,' says he (L.), 'I'm the owner.'" This will be of use to antiquarians of the future; just as those of our own day are enlightened by the record showing the real history of little Jack Horner, and the real nature of the plum he so deftly abstracted.

these squares, save one, place a number (after the manner of the abomination of desolation to which in our own post-Pyramidal days hath been assigned the name of the "Fifteen Puzzle")—then it may be shown that the number of arrangements which can be made of these fifteen numbers in the aforesaid sixteen squares is equal to the number of miles separating our solar system from that star which, according to the best Egyptological investigations of the date of the Great Pyramid, shone, at its meriodinal culmination, directly down the Great Gallery and its prolongation the ascending passage.

Then comes my ingenious and (outside the Pyramid) scientific friend, Mr. Baxendell, who, accepting the Pyramid dimensions assigned by Professor Smyth, finds other relations which they fulfil equally well, showing, of course, other singular coincidences existing quite independently of the Pyramid. Nay, he finds several independent coincidences for each dimension, failing, apparently, to notice that the most remarkable feature of his paper—the singular closeness of the numerical results—exists (scarcely in diminished degree) if the Pyramid be left entirely out of the question. Take, for instance, what I find many regard as singularly impressive, the six different formulæ, by which he gets out 1881·59 as the number of inches in the length of the Grand Gallery (which I need hardly say is not known to anything like this degree of exactitude). They are as follows:—

$$\frac{s\pi^3\pi\sqrt{\pi}}{25{,}000} = \frac{es\pi^4}{10\sqrt{SM}} = \frac{\sigma^4\pi\sqrt{\pi}}{400{,}000e^4} = \left(\frac{\sigma^2\sqrt[4]{\pi^3}}{e^2 2\sqrt{10^5}}\right)^2 = \frac{S^2\pi\sqrt{\pi}}{400{,}000\eta^2}$$
$$= \frac{S\sigma^2\pi\sqrt{\pi}}{400{,}000e^2\eta} = 1881{\cdot}59$$

How terrible these formulæ appear, in conjunction with the circumstance, that by taking dates for the Fall, the Exodus, and the birth of Christ, not quite agreeing with those approved by recognised theological authorities, the length of the descending and ascending passages correspond so closely with the intervals between the first and second and the second and third of those events (years representing inches), as to compel us to believe that the Christian dispensation cannot last more years than there are inches in the Grand Gallery. Now these formulæ, when analysed, are found to indicate a number of really curious coincidences between the numbers representing S, the sun's distance, M the moon's, s the sun's diameter, e the earth's (equatorial), σ the diameter of the sun's liquid body—quietly assumed, for we know nothing about it—η another terrestrial diameter, and π the ratio of the circumference to a diameter of a circle. If the Pyramid had no existence, these curious coincidences would remain. The fact that they exist, and are in themselves so singular, shows simply how little value there is in the argument from mere coincidence. Given ten or twenty numbers taken at random from different columns of the *Times* newspaper, or the dimensions of a house, or field, or piece of furniture, or, in fine, taken from anywhere we like, it will be found that with a little patience, any number of coincidences may be found among the numbers themselves, or connecting them with any other set of numbers, with the dimensions of the solar system, with the volumes, diameters, densities, &c., of the planets, or, in fine, with whatsoever we please. One of the best proofs ever given of this is found in the multitude of relations, independent of the Pyramid, which have turned up while Pyramidalists have been endeavouring to connect the Pyramid with the solar system. These coincidences are altogether more curious than any coincidence between the Pyramid and astronomical numbers; the former are as close and remarkable as they are real, the latter, which are only imaginary, have only been established by the process which schoolboys call "fudging,"—and now new measures have left the work to be done all over again.

BRAIN TROUBLES.

Punning.

IT is not, perhaps, commonly known that a tendency to make puns is regarded by many students of mental physiology as a sign of cerebral disease, a circumstance which we would commend to the notice of those persons who are always on the watch to play upon words, without caring whether their word-play is amusing or not. Whatever opinion we form respecting puns, between the extreme views that a man who would make a pun would pick a pocket, and, as Hood extravagantly maintained (in reply to the saying that puns are the lowest form of wit), that puns are the foundation of all wit, there can be no doubt that puns of a certain sort indicate a ready, bright, and witty mind. But the wit of a punning remark depends entirely on the ideas conveyed by the word or words used in a double sense, not on the pun itself. We laugh at the lines—

> They went and told the Sexton,
> And the Sexton toll'd the bell,

because of the absurdity of the ideas suggested. We are struck by the cleverness of other puns, because of the truth of the words, in whatever sense we understand the words played on. But we find nothing amusing or clever when a second meaning, neither humorous nor sensible in itself, is given to anything that has been said in ordinary conversation; and when a confirmed punster seizes every word capable of bearing two meanings, and expects us to laugh at his word-play, we not only are not amused, but soon become unutterably bored. Yet, although it implies a wrongly-directed mind to make puns in this purposeless way, under the impression that they are amusing, it does not necessarily imply impending idiocy or insanity; for in the majority of cases of this kind, the punster does not yield to an impulse to play upon words, but works very hard to acquire the trick of verbal torturing. He may be compared to one who, having observed that the tricks of a clever clown have been received with approval, tries to excite equal merriment by grimaces which are not in the least funny, and which, if he really could not help making them, would indicate either that he was insane, or else that he had St. Vitus's dance or some other nervous disease. Precisely as such buffoonery would, in reality, signify only want of sense, not insanity or disease, so the habit of making witless puns implies only a feeble, not a diseased, mind. The case is different, however, when one who is sensible enough to see the folly of mere word-twisting finds his mind turning, as it were, against his will, to the profitless task. We cannot fail to recognise the signs of incipient brain mischief, for instance, when we see Swift taking pains to twist the name of "Alexander the Great," into "all eggs under the grate." It would have been a bad sign if he had made so wretched a joke in conversation, though an ordinary mind might have done so without suggesting the idea that the mental machinery was out of order; but that the author of "The Tale of a Tub," should be at the pains to write down such nonsense was of evil portent indeed. The matter might seem trifling enough in itself, as would it be a matter intrinsically of small moment if Mr. Gladstone or the Bishop of London chose to walk down Pall Mall in a nightcap instead of their customary head-gear; but no one who rightly understands mental phenomena could doubt

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that Swift's mind was beginning to be affected when he made such feeble jokes, any more than he would doubt that a great statesman or a grave prelate who should walk along a London street in night attire was, for the time being, at any rate, insane.

Probably, few persons who have had occasion to tax their mental powers at times to the utmost, have failed to notice this tendency to play idly with words, among other symptoms of want of rest. When noticed under such circumstances, the peculiarity need not be regarded as alarming. If, however, it remains after rest has been obtained, it indicates the necessity for relaxation of a more effective kind.

And here we feel called on to object strongly to a remedy suggested in a little book on "Common Mind Troubles," for the errors in speech characteristic of impaired mental vigour, namely, "reading aloud in one language from a work written in another, for example, a French book to an English audience." It would be as reasonable to recommend persons who showed symptoms of bodily weariness to try the effect of an hour's exercise with Indian clubs or heavy dumb-bells. The proper course is to take rest as soon as possible, and above all things to avoid the mistake of seeking in distraction of the thoughts (which is only another form of "worry") for the good effects which can only be expected from relaxation. Some of the most melancholy cases of mental break-down have been caused far more by social worries sought as remedies, than by the excessive brain work to which they have been too hastily attributed.

Reviews.

CELESTIAL OBJECTS FOR COMMON TELESCOPES.*

THE first edition of this work seemed to us one of the most charming little books on astronomy ever written; the second scarce less so; the third still endeared to us by recollections of its simpler predecessors; the fourth is the first which seems overweighted by details and minutiæ. Perhaps, if we had seen the fourth first, we should have liked it as well as we did the first; yet it cannot be denied that many pages of the work before us are calculated to alarm, rather than attract, the young student of astronomy, for whom the book is specially intended.

The charm of the earlier edition lay, perhaps, a good deal in a certain *insouciance* of style, a neglect of nouns substantive, and of too strict rules of syntax, which was suggestive of enthusiasm. The subject seemed to run away with the writer. Take, for instance, the opening sentences of the chapter on Venus. "The most beautiful of heavenly bodies to the unaided eye is often a source of disappointment in the telescope." (We know somehow—we cannot tell how—that this is not a general proposition.) "For the most part it resists all questioning beyond that of Galileo, to whom its phases revealed the confirmation of the Copernican theory—an important discovery" (not the theory, nor the confirmation) "which he involved for a season in the following ingenious Latin transposition," &c., the well-known anagram about the phases of Venus. Then the work much better deserves to be called Astronomy without Mathematics—and, therefore, to be widely popular—than Sir Edmund Beckett's really profound and masterly treatise, so-called. Take, for instance, the following recipe for drawing the disc of Jupiter:—"Make a rectangle 15 high, 16 wide, on any convenient scale of equal parts; find its centre by intersecting diagonals; from this describe a circle touching the top and bottom, and then *pull out*, as it were, the sides of the circle to touch the ends of the rectangle, altering the curves by eye and hand till a tolerable ellipsis is produced." Could anything be less formal or less trammelled by mathematical phraseology than this? The absence of those provoking attempts at explanation to be found in some astronomical books is another charming feature of the work before us. We have, instead, such expressions as,—"Here explanation is set at defiance!" "What could it have been?" and so forth; nothing to weary the learner, or unduly tax his reflective faculties.

If Mr. Webb is unwilling to weary his readers, he has evidently not spared his own labours. The book is crowded with information, notes, references, personal experience, strange out-of-the-way facts: it is, in fact, a storehouse of astronomic lore. There is nothing like it in its own line; and though the fourth edition goes far to establish old Hesiod's saying, that the half may be better than the whole, it is a work without which no astronomical library (not possessing an earlier edition) would be complete. We could have wished Green's Map of Mars had been reproduced here, instead of the one Mr. Webb has given, which is unlike anything in the heavens above, or elsewhere. But such faults are few.

* *Celestial Objects for Common Telescopes.* By Rev. T. W. Webb. Fourth Edition. (Longmans, Green, & Co., London.) Price 10s.

A Horse's Pastime.—A few years ago, while in North Staffordshire, I saw a horse amusing himself in a rather original manner. On one of the trees at the side of his field, next the road, was a branch about a yard from the ground. The horse stood on this branch with his hind legs, and, planting his fore-feet firmly on the ground, as a fulcrum, gravely see-sawed up and down by swaying the bough, getting on again when he slipped off. He appeared to derive a sort of solemn pleasure from the proceeding.—Titteswortth.

A Generous Bulldog.—My children went out for a walk—girl 12, boy 10 years—taking my dog, a cross-bred bull and terrier, also a retriever dog, belonging to a relative. This latter entered a large reservoir, on being told to do so, and paddled about for some time, amusing the children. By-and-bye he swam amongst some rushes, and they appeared too strong for him to fight his way out. He was called, but seemed exhausting himself and unable to obey. The children called louder, and were, in fact, getting frightened, when our dog, who was on the bank, jumped into the water, swam up to the retriever, seized him by one ear, and, being a strong, muscular animal, he dragged the retriever to land. On getting out, instead of fighting on account of the punishment the retriever had received, they fell to licking each other in a most affectionate manner. Was this instinct?—J. Davidson.

Cod-Sound.—The meaning of this word "sound" for the aorta, or chief blood-vessel, of the cod-fish goes deeper than *sondre*, to sever, or sunder, suggested by Mr. W. M. Williams (p. 295). The root-word is common to several of the chief groups of languages. *Son*, or *sona*, in Sanskrit, is red, blood-coloured; *sonita* is blood. In the Dravidian dialects, *sen* is red, or blood. *Sen* is blood in Egyptian, whence the derivation *senn.t* denotes that foundation which in biology is blood. So, in Chinese *sen* is foundation; the heart itself, as well as heart figuratively, the inward and essential basis of being. The Assyrian *sunn* also denotes fulcrum and foundation. These meanings all meet in the fish-*sound*, as that which contains the blood, the basis of life, and the name shows how much significance may be concentrated in a single word.—Gerald Massey.

Fox Story.—I can hardly distinguish the action of the fox in the following case from reason. It happened in co. Roscommon, at Kilronan Castle, where I once lived. The foxes this particular time were doing great damage to the pheasants, so the preserves were poisoned. When, in some instances, the keepers went to see if the meat had been taken, they found filth placed on the top by the fox. I have also known of a case where a fox was caught in the evening and put into a barn for the night. When, in the morning, one of the family went out to see if he was safe, he found him on the ground, as he thought, quite dead. He caught him by the tail, the fox not relaxing a muscle, but keeping quite stiff and stark. He rushed into the house to tell the news, when, coming out, he saw reynard running away as fast as he could.—Constans.

EASY LESSONS IN BLOWPIPE CHEMISTRY.

By Lieut.-Colonel W. A. Ross, late R.A.

Lesson III.—MANGANESE—COBALT—GOLD.

(*Note Introductory.*)

I SEE your typographical demon has promoted me into the Royal Navy (one of the best pyrologists I know is a Captain R.N.), and should think the printer's other inference, that the rank of colonel has been lately created in the English navy, is also a mistaken one.—*Erratum* in Lesson I. It should be stated that the two "body tubes" of the blowpipe are "two 6-inch pieces"—*not* "2 in. pieces." In Lesson II., (1) the firm in Hatton-garden is "Johnson & Matthey," *not* "Johnson & Mather." (2) Freiberg is wrongly spelled with a *u*, not by me!

I hope some of my sharper pupils, having tried the experiment with oxide of manganese, detailed in Lesson II., will find out that I have omitted to mention a very remarkable "reaction" (which is the chemical term for a phenomenon depending upon the application of any particular operation). It is this:—On first heating the manganese (brown) oxide* with the phosphoric acid, great effervescence, or bubbling, takes place, and the bubbles are tinged a deep crimson colour. This extremely delicate reaction will detect 0·05 of manganese in minerals or compounds. The phenomenon described in the final paragraph of Lesson II. is evidently the result of holding the bead (on platinum wire) in two different positions as regards the blue, blowpipe-pyrocone. In any position (*a*) in front of the "tip or point of the blue," as it is called, the manganiferous bead assumes an "amethyst," or bluish-violet colour; in any position within the blue, the bead becomes colourless (*b*).

Position (*a*) is called in most blowpipe books "the oxidating flame," or briefly, OF. Position (*b*) "the reducing flame," or RF. I have altered these names in my books, because they do not correctly describe the resulting reactions. In the first place, there is no "flame" at all, but, instead, a cone of non-luminous, blue fire; secondly, many beads (an auriferous, or gold-bearing bead, for instance), so far from being oxidised just in front of the blue tip, suffer a deoxidising or "reducing" process, whilst the position (*b*) does not invariably reduce all substances dissolved in these beads—oxide of chromium, for instance—and produces many phenomena besides reduction, as that of "colouration," "precipitation," &c.† I have therefore, thought it better to describe these important situations of the subject of analysis by symbols expressing the *nature* of the fire which, in that position, attacks it, thus:—HP (instead of RF) for hydrocarbonous‡ pyrocone; OP (instead of OF) for oxyhydrogen pyrocone, and PP (no old name), for peroxidising pyrocone. This last position extends from ½ in. to 2 in., or even 3 in.—if the blast is sufficiently strong—in front of the "blue tip." Let us now revert to our phosphoric, manganiferous§ bead (these are rather long words, but necessary, and easily learned and remembered by the real student). Chemists have ascertained that the common or brown oxide of manganese contains two proportions or parts of oxygen to one of the metal manganese. Their symbol for manganese is Mn, and they, therefore, symbolise this compound thus: MnO_2. They have also found that the "red," or violet oxide contains the proportion three of metal to four of oxygen, and have thus symbolised it Mn_3O_4.

The chemical action of the different parts of the blowpipe pyrocone, therefore, is admirably illustrated by the Mn. bead; for, as we have seen, the relative proportions of metal and oxygen of the compound dissolved in it are actually and materially altered by a simple movement of the hand! The lowest—that is, the nearest metal—known oxide of manganese, is what chemists call the "monoxide,"‖ MnO (obtained by heating the common carbonate in a gun-barrel, through which hydrogen gas is passed), and is a *green* powder; what oxide, therefore, the *colourless* bead after treatment in HP, contains, is not yet, apparently, known.

One of the greatest chemists that ever lived, in days when great chemists did not despise the blowpipe, discovered this curious reaction of manganese in borax. His name was Scheele. He was at first only an apothecary at Köping, in Sweden.

I am now going to ask my student to make another "bead," still prettier than the last, by means of a substance almost as cheap as manganese, and he should go to the same place for it—viz., to the glass-works; I mean oxide of cobalt. The minerals in which cobalt was first found in Germany were so like silver, that when the miners found they did not contain silver, they said they must have been silver changed in character, or be-devilled by some demon, and *Kobold* is the German for demon.

The phosphoric acid, or, in brief, P. acid-bead, is tinged with cobalt oxide, or CoO, in the same manner as the former one was with MnO_2 (see Lesson II.), but see what a different result we have got! *This* bead is blue hot, but in cooling assumes a magnificent violet colour. It is not altered in appearance by holding it in the positions OP, or HP, or PP—all cause it to be blue hot and violet cold. In all blowpipe tables and books (except mine), you will see "blue" only set against cobalt; but in 1869 I discovered that P. acid gives this beautiful colour with cobalt, and thought that by adding a weighed quantity of soda to the bead before the blowpipe (or briefly, BB) until it remains blue cold, I should obtain a kind of *measure* for the soda added; and, as the bead is thus made blue by any alkali—an alkalimeter,* or alkali-measurer; and this is the fact. You can also measure the quantity of cobalt in minerals, &c., in this way, and in my little book, "An Alphabetical Manual of Blowpipe Analysis," pp. 45 to 48, is given "A Blowpipe Assay of Ores, Furnace Products, &c., for Cobalt."

Now, we must try another substance with, or in, our little chemist P. Acid, and the student need not be alarmed at my extravagance when I tell him it is to be—gold. A tiny little bit of gold-leaf (which should be quite pure, or he will get colour reactions for copper, &c.) about twice the size of a pin's head, cut off with the point of a pen-knife, is taken up at the bottom of a red-hot P. Acid bead, and *kept* there, or it will fly up and alloy the platinum wire, in which event another piece of gold is to be added, under a powerful OP, when the gold will be rapidly dissolved (no other single known acid is sufficiently powerful to do this), and its oxide, as I have before stated, precipitated in this position, making the bead "muddy." The student is now to take up a small fragment of P. Acid at bottom of the hot bead, and hold it steadily in a good PP, just over half-an-inch from the tip of the blue. When the proper amount of oxidation has been applied to the bead in this position, which occupies a time, varying with the blower's capabilities and the perfectness or otherwise of the pyrocone, the auriferous bead will be observed to be a brilliant topaz-yellow when *very* hot; then, in cooling, to become green; then greenish-blue; and lastly, when nearly quite cold, a beautiful blue-violet colour, called, when otherwise obtained, "the purple of Cassius."

Colonel Ross begs to inform Major James Cummings (Query, page 347) and other intending pyrologists, that he will be happy to reply to any private queries on the subject, briefly but concisely put, if sent to him with an enclosed stamped envelope to the following address:—Acton House, Acton, London, W.

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* *Oxygen* (acid generating).—A gas discovered by an Englishman (Priestley) in Birmingham in 1772. It is a component of almost all natural inorganic substances.

† *Precipitation* (a falling down) is the condition when a bead becomes "muddy" or opalescent, which before was transparent, or "clear." The oxide, or substance which before was dissolved in the clear bead, has, by some act, become insoluble, and is "precipitated."

‡ *Hydrogen* (water generator), a gas; with oxygen forms water, and in that form is a constituent of almost all substances, organic and inorganic. It is also with carbon, a component of oils, fats, &c., which are called "hydro-carbons," and therefore, of the ignited gases proceeding from them when burned.

§ *Manganiferous.*—Bearing (or containing) manganese.

‖ *Monoxide.*—Greek Monos one, and oxide.

* *Alkali* (Arabic, Al-kali), the reverse of acid; alkalies turn red, moistened litmus-papers blue; acids turn blue litmus-papers red. Two of the three alkaline metals, potassium and sodium, were discovered by a Cornishman (Davy) in London in 1805 by means of the "Voltaic pile." *Alkalimeter*—alkali and *meter* (Greek)—a measure.

THE BRAIN AND SKULL.

SOME correspondence has taken place in Knowledge relating to the human brain and its outer envelope, the skull. It has, therefore, seemed to me that a few notes upon facts well known to anthropologists and craniologists would probably be acceptable to readers of Knowledge.

There exists among numerous barbarous and semi-civilised peoples, scattered over the world, a very curious custom, perhaps it may rather be called *fashion*, of deforming the skull in infancy. This custom has existed from the most remote period, so that in some localities it is very difficult to obtain a skull, the measurements of which can be relied upon as distinctive of race, from the ancient graves. The ancient Peruvians were particularly addicted to the deformation of the skull, and the practice still exists among the American Indians; but the most curious of all these artificially-deformed skulls are those brought from the island of Mallicolo, in the new Hebrides group, a tracing of one of which I

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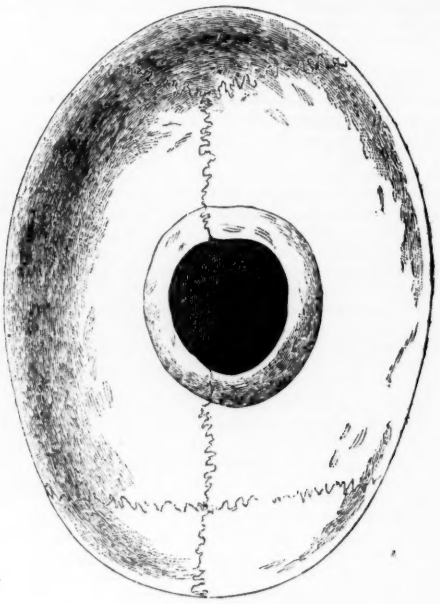
here give from a paper in the Journal of the Anthropological Institute for November, 1881, in which this skull and others exceedingly interesting and curious from the same island are described by Professor Flower, the originals being in the Museum of the Royal College of Surgeons. Here it will be seen that the skull has been worked up into a most singular form, scarcely resembling that of a human being, and this has been evidently effected in infancy by means of a tight bandage bound round and round the head, and only allowing of expansion in one direction. A different mode is adopted by some of the American tribes, as the Flat Heads, who affix a board at right angles to that upon which the infant is carried, which, being strapped down tightly over the forehead, causes it to become depressed, while the skull bulges at the sides. A drawing of this cruel method of producing a fashionably-shaped head may be found in Catlin's work on the American Indians; and these two modes, the tight bandage round the head and the flat boards, seem to be those chiefly adopted for producing the desired form. The first of these, that of compression by tight bandages wound round and round the infant's head, may have originated in the supposed necessity for aiding nature in uniting the bones of the skull, open, as we know, at birth, and long after; in fact bandages for this purpose seem to have been used in our own country and France up to quite a recent period, and, of course, a little extra tightness would soon produce a deformity. This method, therefore, can hardly be looked upon as characteristic of race, although, doubtless, the production of a certain form soon became a fashion among many races, as among the ancient Peruvians, whose skulls strongly resemble the one here figured, and Professor Flower also mentions some from Tiflis and Hungary of a similar form; but the other method, whereby the infant's head is compressed between two boards, would seem at present to be confined to certain tribes in North America, and, as it would not appear to subserve any apparently useful purpose, it is probably distinctive of race. In all cases these deformations are generally marks of distinction, like the deformed feet of Chinese women, and often a caste privilege, reserved for chiefs and their families, under which aspect the fact becomes doubly interesting; for we know that among savages chiefs are chosen for their superior mental and bodily powers. Hence it would seem that this compression of the skull, and the consequent forcing of the brain into an abnormal form, has no deleterious effect upon the intellect; in fact, Cook and the two Fosters, who first noticed the peculiar conformation of the heads of the people of Mallicolo on their visit to the island in 1774, although uncertain as to how it was produced, speak of them as "the most intelligent people we had ever met with in the South Seas." This must be a puzzling problem for phrenologists, for it goes to prove that when the volume of the brain remains intact, the form is immaterial, even though that form may be artificially produced with great pain. It would appear that the deformation among the Mallicolese is not confined to the chiefs, but is practised by all alike, without distinction of class or sex, and is produced by a tight bandage applied to the head shortly after birth, extending from the eyebrows to the hair, and only taken off occasionally, until the child is six months or a year old.

Certainly, inferior races in modern times think little of inflicting pain, in which, probably, they resemble the ancients; for singular instances of a surgical operation performed upon the skull of young children in the later Stone Age are found in tombs in France and other parts of Europe. The late Dr. Broca, the eminent French anthropologist, was the first to notice this singular fact. Many skulls had been found in tombs belonging, without doubt, to the Stone Age, in which holes of considerable size had been made, evidently during life, as the wounded bone had become healed, and in most cases it was evident that the head had increased in size after the operation, proving that the trepanning had taken place at a very early age. I have here copied from Dr. Broca's book one of these curious skulls, with the large hole just on the top, and it seems wonderful that a child could survive such a serious operation, and live to maturity, or even old age, with the brain thus exposed; for it must be remembered that this operation, which is now performed, when necessary (as in cases of fracture), by a very perfect instrument, which cuts through the bone very rapidly, holding and lifting the piece to be removed at the same time, was in those remote times effected by slowly grating away the substance of the skull with a flint scraper, at the cost of intense pain to the suffering infant. Yet these sufferers frequently grew up, as is proved by their remains, and apparently were greatly venerated, perhaps on account of the operation they had successfully endured; for Dr. Broca has also proved that, after death, pieces were cut from the skull thus mutilated, and worn as amulets, probably to ward off epilepsy, which was the disease supposed to be cured by this barbarous operation; and as epilepsy has in all ages been looked upon as brought about by evil spirits, it is regarded as proved that the early people who thus endeavoured to cure this terrible malady had a belief in spirits, and made this hole in the head of an afflicted infant in order that the imprisoned spirit might find a door of escape, and thus, by an easy transition, the amulet taken from the mutilated skull became a charm against evil spirits.

From the instances cited above, it will be evident that the brain-case has been very unceremoniously treated by savages and semi-civilised races both in ancient and modern times, and that the

Artificially deformed skull, from Mallicolo, New Hebrides. Copied from Journal of the Anthropological Institute, vol. xi., p. 78.



Trepanned, or perforated skull; from tomb of Stone Age in France. Copied from Dr. Broca's book, "Sur la Trépannation du Crâne."

results of this treatment do not appear to have been detrimental either to health or intellect; and although the weakly, in all probability, died early, those who survived, inured to pain and endurance from the cradle, grew up hardy and able to bear suffering, which would soon kill our more tenderly-nurtured and abnormally-sensitive children. These curious facts seem to me worthy of more attention than they have hitherto received from medical men and psychologists, and I trust some of the readers of KNOWLEDGE may be induced by this imperfect and too short description to investigate this very curious subject. A. W. BUCKLAND.

INTELLIGENCE IN ANIMALS.

AT one time our family rejoiced in the possession of five cats. One, a magnificent black animal, assumed the air and dignity of chief amongst them, and was deferred to on all occasions by the other members of the feline community. One day I detected him in the commission of an outrageous attack on a juvenile member of the fraternity, and at once expressed my disapprobation in a most vigorous manner, chasing the culprit about the room, under chairs and tables, till he suddenly disappeared.

I listened a moment to catch any sound that might betray his whereabouts, and suddenly heard the latch of the kitchen-door fall. I rushed into the kitchen just in time to see Tom slide his forepaw between the door and the jamb, forcing the door open and leaping out into the garden, thence on to the top of a high wall, from which "bad eminence" he regarded me with a placid and unctuous look of injured innocence.

He had opened the door by jumping on to a small shelf near, from whence, by standing up on his hind legs, he could reach the latch and push it up with his forepaw, thus releasing the door, which then swung partially open. The rest, to a cat of "Sweep's" intelligence, was easy. I often afterwards watched him do it. He never succeeded (though he often tried) in opening the door from the outside, because there was nothing sufficiently near the latch on which he could stand while he pressed the thumb-piece of the latch downwards, a proceeding the necessity for which he evidently thoroughly understood, as evidenced by the way in which his attempts to open the door from the outside were made. He would leap up and catch hold of the latch-guard with one paw, while with the other he frantically struck (downwards) at the thumb-piece, continuing his efforts till his strength for the moment failed him, and he dropped to the ground.

He never asked anyone to open the door for him. If he wanted to go out, he opened it and went out; if he wanted to come in, he *tried* to open it, and continued trying (the idea of ultimate failure never, apparently, entering his head) till the noise of his successive failures attracted notice and brought help. JOHN HUMPHREY.

WE had several times been annoyed by joints of meat having been gnawed, and often found on the floor of the cellar; of course, the cat, about three-quarters grown, was rightly blamed as being the delinquent. The maid repeatedly denied having left the cellar door open, but was for some time disbelieved, and I am sorry to say blamed, until one night, going into the kitchen after the family had retired, I found pussy, naught abashed, busily pawing away at the thumb-piece of the latch. I left her for a short time, and on returning found the cellar door open, and pussy busy with the meat. On examination I found the door would immediately swing open on the lever of the latch being pressed. Next day I had a spring put to the latch, and, needless to say, pussy has not troubled since, though it is not for want of trying. She still lets herself into the kitchen from the garden—the outer-door having a similar latch, climbing up the verandah until level with the latch, and pawing away industriously until the door swings open.

W. M.

ANIMAL INSTINCTS.—A lady, daughter of a neighbour of mine, married to a Russian, and who travelled with him and resided some time in Eastern Siberia, told me an anecdote of some swallows, which she said were building their nests under the verandah of their domicile there. One of the nests, when about completed, was found on the return of the builders to be occupied by a sparrow, whom they in vain tried to eject. On finding their efforts fruitless, they started off to the neighbouring river, from whose banks they acquired their plastic material, and in numbers proceeded at once to fill up the hole into the nest. In the evening, Madame S——a's husband, by mounting a ladder, found they had completely filled it up, and he at once, with his fingers, re-opened the hole so as to allow breathing space to the little occupant. Alas! in the morning, when they came to breakfast, he found the hole refilled, and the bird inside quite dead from suffocation.—T. H. MORGAN.

Letters to the Editor.

[The Editor does not hold himself responsible for the opinions of his correspondents. He cannot undertake to return manuscripts or to correspond with their writers. All communications should be as short as possible, consistently with full and clear statements of the writer's meaning.]

All Editorial communications should be addressed to the Editor of KNOWLEDGE; *all Business communications to the Publishers, at the Office, 74, Great Queen-street, W.C.*

All Remittances, Cheques, and Post-Office Orders should be made payable to Messrs. Wyman & Sons.

**** All letters to the Editor will be Numbered. For convenience of reference, correspondents, when referring to any letter, will oblige by mentioning its number and the page on which it appears.*

All Letters or Queries to the Editor which require attention in the current issue of KNOWLEDGE, *should reach the Publishing Office not later than the Saturday preceding the day of publication.*

(I.) Letters to have a chance of appearing must be concise; they must be drawn up in the form adopted for letters here, so that they may go untouched to the printers; private communications, therefore, as well as queries, or replies to queries (intended to appear as such) should be written on separate leaves.

(II.) Queries and replies should be even more concise than letters; and drawn up in the form in which they are here presented, with brackets for number in case of queries, and the proper query number (bracketed) in case of replies.

(III.) Letters, queries, and replies which (either because too long, or unsuitable, or dealing with matters which others have discussed, or for any other reason) cannot find place here, will either be briefly referred to in answers to correspondents, or acknowledged in a column reserved for the purpose.

"In knowledge, that man only is to be contemned and despised who is not in a state of transition. . . . . Nor is there anything more adverse to accuracy than fixity of opinion."—*Faraday.*

"There is no harm in making a mistake, but great harm in making none. Show me a man who makes no mistakes, and I will show you a man who has done nothing."—*Liebig.*

"God's Orthodoxy is Truth."—*Charles Kingsley.*

Our Correspondence Columns.

ERRATUM.—WEATHER FORECASTS.—MESMERISM.—ICE.—SHORTENING OF THE DAY.—FOSSILS IN METEORITES.—THE ATOMIC THEORY.—HISTORY OF NATURAL PHILOSOPHY.—BAROMETRIC OSCILLATIONS.—VEGETARIANISM.—THE POLAR SUN.—LECTURES.

[285]—I must begin by correcting a remarkable compositor's error in the ninth line of the second paragraph of my letter (255) on p. 296, as I there find "2,141,956 miles," where I most certainly wrote 214,956; on the whole, a very decidedly shorter distance.

Either the author of letter 256 (p. 296) must contribute infinitesimally to the taxes, or, like the Scotchman in the parable, he must be "thankfu' for sma' maircies," if he is satisfied with the return which the British nation receives for the annual sum of £15,000 expended on so-called "Meteorology." Were payment to Victoria-street and the Royal Society Committee made by results, I have an abiding conviction that a very considerably less sum would appear in the estimates next April.

I should strongly recommend "A Startled One" (letter 260, p. 301) to obtain a little book by the late Mr. Braid, of Manchester, entitled "Magic, Witchcraft, Animal Magnetism, Hypnotism, and Electro-Biology." It was published by Churchills in 1852, and is now out of print; but I should think that a copy might be obtained through a second-hand bookseller. Your correspondent may also read Carpenter's "Mental Physiology" (H. S. King & Co.) with profit.

Will "An Engineer" (letter 262, p. 301) forgive me for saying that I made no "slip" in the sentence which he quotes. All I meant to imply was that ice did not vary *in the same way* as other solids do with change of temperature—not that it did not so vary at all. I should say just the same thing of bismuth, antimony, and cast-iron.

"A Geologist" (letter 263, p. 301) appears to labour under the impression that the rate of the earth's rotation is dependent in some fashion upon her internal temperature. The most probable efficient cause of the lengthening of the day is, however, the friction of the tidal wave upon the earth's surface, as this must really retard her diurnal rotation on her axis, and produce the effect of a brake. As the Editor points out in his own note, unless we admit that the day is lengthening (at the rate of about ten seconds in 100 years) at least half of the apparent lunar acceleration is unaccounted for.

I have never seen the "Poetry of Astronomy," and so am ignorant of the line of argument pursued therein by its author with reference

to Meteorites (of which Mr. Vignoles speaks in letter 267, p. 302). Some recent pretended discoveries of fossil sponges, corals, and other forms of Zoophytic life in Meteorites have, though, been shown conclusively to be baseless, examinations of the meteorites under the miscroscope having demonstrated the purely crystalline character of the alleged organic markings. It is, on the whole, just as well to have one's facts right before beginning to theorize.

Probably Wurtz's "Atomic Theory" (Vol. XXX. of the "International Scientific Series") would be the best book for "Ernest L. L." (query 219, p. 303) to obtain; it is the most recent one on the subject.

Mr. Summerson (query 221, p. 303) seems to be unaware that there is an exceedingly great technical difference between "Philosophy" and "Natural philosophy." The latter is only another word for what is now known as "Physics." The former has reference wholly to mental philosophy or metaphysics. With this preliminary warning, I may say that Whewell's "History of the Inductive Sciences" is the most exhaustive work that I am acquainted with on the subject. I believe that Miss Arabella Buckley has comparatively recently written a more compendious book on the History of Physical Science; but I have at this instant forgotten its exact title. Anything she does is sure to be good. There is a History of Science, too, by Mr. Routledge, which I have seen, and which, as far as I could determine from dipping into it, seemed very well done.

I presume that "G. R. W." (in query 227, p. 303), on the subject of Barometric Oscillations, refers to a phenomenon with which I—and I presume many others—have long been familiar. The effect to me of the oscillation of the mercury during a storm is irresistibly suggestive of *breathing*. I have watched it on many occasions, and the rhythmical rise and fall of its surface puts one at once in mind of the measured movement of the chest of a sleeping person. The Editor's explanation of this is obviously the correct one.

Doctress Kingsford (letter 276 p. 322), and some of her *confrères* appear to misinterpret the position which I have assumed towards vegetarianism. I have never denied or disputed, for example, that a severe course of City-feeding might with great advantage be followed by a purely vegetable regimen, until the effects of over-eating had passed away. Nor am I concerned to contest that individuals may be so constituted as to thrive fairly well without eating meat at all. What however I protest, and shall continue to protest against, is the tone assumed by the "whole-hog" vegetarians. "I wish," said an eminent statesman of the late Lord Macaulay, "I wish that I were as cock-sure of anything, as Tom Macaulay is of everything." It is this "cock-sure" demeanour of the phytophagists, this blatant assertion that they *must* be right, and all the rest of the universe wrong, which is as irritating as it is unconvincing. As a class, they are in reality as weak numerically as they are intellectually; but to read their published utterances one would think that in mental capacity as in numbers they infinitely surpassed the remainder of their fellow men (and women). How (letter 277) a total exclusion of flesh, with the substitution of suitable vegetable products would give me "yet better health" than, I am thankful to say, I invariably enjoy, I wholly fail to perceive. Moreover, when I regard the potato-fed Irishman, and see what his diet has brought him to, or study the rice-eating Hindoo, and note his slavishness and utter pusillanimity, I do not derive much practical encouragement to eschew fish and meat henceforth and for ever. One question I should, in conclusion, like to have answered. I perpetually see the names of Dr. B. W. Richardson and Sir Henry Thompson quoted as strong advocates of vegetarianism. Now, my question is this. Does either of these gentlemen restrict himself to vegetable food? *Ars probat artificem.* "The proof of the pudding is in the eating." It is useless to repeat with the clergyman of old the anecdote, "Do as I say, not as I do." If the two eminent men whom I have named do not themselves practise what they preach, the publication of their testimony must, I venture to think, have a precisely opposite tendency to that hoped for, and intended by, those who cite it.

A few elementary considerations will enable R. W. I. (query 236, p. 323), to answer his own questions. Actually at the North Pole the diurnal circle of any heavenly body—assuming such body to remain stationary in the sky—is rigidly parallel to the horizon; the horizon in turn coinciding with the celestial equator ("The Equinoctial" of the maps and globes). Very well, then, neglecting the effect of refraction, it is quite obvious that as long as the sun is south of the equator, or has south declination, he must be invisible from the pôle; but that, as soon as his upper limb touches the equator, he will begin to rise. In these latitudes sunrise and sunset are phenomena referable to the axial rotation of the earth, but this quite evidently cannot be the case at the Pole, where, as I have said above, the diurnal circle of a star is parallel to the horizon. The sun, then, at the North Pole will only rise at the same rate as he increases in north declination. Let us take March 21, when he has been invisible there for six months. We find from the *Nautical Almanac*, that between the 20th and 21st the sun is moving northward at a mean rate of 59·23″ per hour. At this date his diameter is 32′ 10·1″, or 1930·1″. If, then, we divide 1930·1″ by 59·23″, we shall obtain 32·5865, the number of hours the sun will occupy in rising. During 24 out of these 32·5865 hours, the earth will have turned once on her axis, so that the rising sun will have travelled through 360° [more nearly 361°.—Ed.] of the horizon. There are, however, yet 8·5865 hours to elapse ere he will be wholly above the horizon; and during this period the arc he describes may be approximately found by the proportion 24 : 8·5865 :: 360° : the arc required [with a slight correction for refraction.—Ed.].

I should think that "X. X." (query 244) would find Mayer and Barnard's little book on "Light," and Mayer on "Sound," both in the *Nature* series, the very things for him. Tomlinson's "Pneumatics," in Weale's series, will furnish him with numerous interesting facts about the atmosphere; and Tyndall's "Lessons in Electricity," published by Longmans, will supply him with all he needs for a lecture or lectures on the subject on which it treats.

A Fellow of the Royal Astronomical Society.

FLEXURE IN PLANES.

[286]—There has been a bad epidemic of flexure among planes lately. From all directions I have heard that their sufferings have been severe; I have also suffered with them. Will you allow me to state through your columns, without encroaching unduly upon your valuable space, that in every case I have traced the flexure to ill-treatment on the part of the possessors of the planes. They have been subjected to torture; they have been firmly wedged into cells too small for them; they have had pieces of card jammed in behind them; they have had screws and clips binding them; but, above and beyond all, they have been cemented on to wooden blocks and metal plates with hard cement, the cooling or setting of which has entirely altered their figure. I wish, then, to take advantage of your kindness to inform all those who are interested in the subject, that planes will not give accurate definition under high powers if they are subject to restraint in any way. A glass plane ¼-in. thick, if attached to a block by a wafer, which is allowed to get hard, will show, as a result, flexure, and give a bad definition.

John Browning.

INTERIOR HEAT OF THE EARTH.

[287]—This is a subject in which I have always taken a deep interest, and have followed attentively all that has been published in connection with it for many years. I have, therefore, been much surprised at meeting with no allusion in any of our English scientific works or periodicals to a book published in Germany so long ago as 1875 (I give the title of the book below), and which, I understand, met with considerable support from geologists in that country.*

The author (since dead) was Professor of Chemistry and Physics at Bonn, and professes to found his theories on chemical and physical principles, as ascertained by the latest researches.

He entirely rejects Laplace's "Nebular Theory of the Formation of the Earth," denies on chemical and physical grounds its interior heat, and adduces, among other proofs, the results of a great boring undertaken by the Prussian Government in 1870-71, at a place near Berlin, which was carried to a depth of 4,517 ft., mostly through a continuous stratum of rock salt. The heat at first increased at the rate of 1° for 60 ft., but after reaching the depth of 2,000 ft., this increment gradually diminished, so that instead of being 140° at the bottom of the boring, it was only 113°.

He has a new theory to account for earthquakes and volcanoes, the former, he thinks, being principally caused by the hollowing out of cavities on the superficial strata by the action of water, and the consequent collapse of these cavities.

He denies the igneous origin of what are called eruptive rocks, and, among other proofs, adduces the fact of his having found, on an analysis of a very hard piece of granite, some of the nodules of hornblende, surrounded by pure asphalt, unchanged, which, he observes, would not have remained there if the rock had been subjected to the action of great heat.

The coal measures, he maintains, were formed entirely by marine plants, of which, he says, there were (and now are) immense forests in the sea.

These and many other theories, entirely opposed to the opinions usually held by geologists in general, he maintains with con-

* Geschichte der Erde; ein Lehrbuch der Geologie auf neuer Grundlage. Von Friedrich Mohr, Professor zu Bonn. Verlag von Cohen und Sohn, Bonn, 1875.

siderable show of reason, and adduces some striking facts in support of them.

Being myself a mere sciolist in geology, or, indeed, on any scientific subject, I can offer no opinion as to the validity of his reasoning in general, but I am anxious to know whether any of your readers have met with the work, and how far it is considered worth attention by English scientific men. B.

Edinburgh, Jan., 1882.

HOG PUZZLE.

[288]—Here is a new hog puzzle, by Lieut.-Col. W. H. Oakes, of arithmetical renown. Some of your readers might like to solve it. You shall, next week, have his solution of it, and also one of the original puzzle in short and simple arithmetical form.

Four married couples went to buy hogs. Each individual bought as many hogs as he or she gave shillings for each hog. Also each husband laid out the same number of guineas more than his wife, and this number of guineas was the smallest consistent with the condition that the numbers of hogs purchased by the respective husbands in excess of the numbers purchased by their respective wives form four consecutive terms of an increasing arithmetical series. How much did each husband expend more than his wife?

HERBERT REES PHILIPPS.

PLATING—ASTRONOMICAL—CHEMICAL.

[289]—I have to thank "C. T. B" for his reminder. He might try the solution described, for iron, but I am of opinion that he will find the only way for iron to be with a battery and alkaline solution. But, surely, "Watts' Dictionary" should help him through.

On page 241, Professor Young says, in effect, that the sun's pull on the earth could only be sustained, or replaced, by a bar of steel many square miles in section. Sir E. Beckett, in "Astronomy without Mathematics," (page 312) tells us:—"The tractive force on a fast railway train of 400 tons, on the level, is found to be about four tons. . . . . But if the earth were such a train, it would exert a *centrifugal* strain of less than five hundredweight on the rope which held it to the sun." These two views are opposed to one another, and therefore one must be incorrect. [Pardon me; the two views are quite consistent with each other. Sir Edmund Beckett says, if the earth were such a train, that is, if her mass were only 400 tons.—ED.]

The account of the manufacture of gas from wood, page 246, also requires elucidation. Carbon monoxide is rather "combustible" than supporting combustion. The finished article is said to be free from "dangerous, obnoxious, and otherwise objectionable products." It would be better worth while to caution one against the exceedingly poisonous properties of this gas; besides which, coal gas is harmless. Unlike the case of carbon dioxide (which is *not* poisonous, and which *has* an odour, whatever our text-books may copy one into another), fresh air does not revive one from suffocation by carbon monoxide. This gas, as is well known, burns with a pale-blue flame (the blue flame often seen over a sluggish fire is CO) of feeble luminosity. How, then, can it confer on "an inferior coal gas" a "great candle power?" Lastly, the CO_2 takes up carbon from the heated charcoal according to the equation—

$$CO_2 + C = 2CO,$$

so that eventually the charcoal disappears, except an ashy residue. Where, then, is the danger of "too great an accumulation of charcoal?" and why withdraw from the retort the substance that is also put into it? LEWIS ARUNDEL.

[The account was not quite clearly written. It seemed obvious, however, that F.C.S. referred to wood gas itself, when burning in the usual way, as innocuous, not to carbonic oxide.—ED.]

ELECTRO-PLATING.

[290]—Letter 119 has evidently escaped the notice of your readers. If I were W. Vaneys, I should throw down the Cu from the solution by means of the battery. Cu in an Ag solution, being thrown down before the Ag. He will understand me, without my taking up any more of your valuable space. F.C.S.

HORSERADISH—INTELLIGENCE OF A CAT—SCENT—"KNOWLEDGE."

[291]—With respect to horseradish, Mr. Henerman must know that it, in common with garlic (*Allium ursinum* and *A. satirum*), onion, leek, eschalot, &c., yields on distillation a fetid-smelling compound oil called allyle, from the genus that it characterises. The astringency of mustard and horseradish (probably also cress, radish, and such like) is due to sulphuret of allyle in combination with cyanogen. I mention the fact that there are other plants having those properties which we value in horseradish to remind Mr. Henerman of the extraordinary proclivity of all nations to use them as condiments. I cannot call to mind a single nation that rejects them; in fact, some people will not be satisfied with anything weaker than *ferula assafœtida*. I do not suppose that horseradish "acts" in any way upon the stomach, although so general a use betokens some effect beneficial, or at least pleasing, to the system. While "warming" the appetite, and, as a condiment, grateful to the taste, it probably has no undesirable effect.

There lives, near where I write, a cat that can without fail open the back-door by springing from the ground to the latch-handle, and, while holding with one paw, can raise the latch with the other, finally swinging the door forward by means of a push with the hind leg. We might almost expect, as a last step to so great reason, a certain amount of culture. But the housewife complains that, having taught itself, to gain its own end, admission, it will not consider further, and close the door again.

"Prester W." himself states about all that is known of the nature of a scent (No. 11, query 170). It is questionable, however, that he is able to recognise a *perceptible* decrease of weight in scent-giving substances. I was under the impression that there was no measurable decrease in weight, but having paid no attention to the subject I await a correction, Dr. Carpenter (in "Comparative Physiology") remarks that "a grain of musk has been kept freely exposed to the air of a room, of which the door and windows were constantly open, for a period of ten years, during all which time the air, though constantly changed, was completely impregnated with the odour of musk; and at the end of that time the particle was not found to have sensibly diminished in weight." Here is an illustration of the extreme minuteness of a molecule!

I express my regret, sir, that you (whose leadership my "set," at least, fully trust) should have been thus far so troubled with *suggestions*. KNOWLEDGE assuredly needs no such small patronising ways, and judging from its rapid spread in this district, it will be the magazine of the future of its sort. CONNERHUGEL.

THE WEATHER OF JANUARY 12-24, 1882.

[292]—Some notes on the weather in the South of Ireland during the past exceptionally mild month may be interesting, as enabling your readers to make comparisons with the weather of more northern and eastern districts. It is not common to observe in winter a high barometer and a high thermometer together, but we have here observed a remarkably high mean of both instruments during a considerable part of the period. During the fortnight Jan. 11-24th, the mean height of the barometer reduced to 32°, and mean sea-level was 30·5 in. The mean of maximum thermometer, was 51·7° of minimum, 43·6°, mean for fortnight, 47·65°. The mean daily temperature was 50° or above, on the 11th, 12th, 13th, 14th, 15th, and 16th, and fell short of it by about half a degree on the 23rd and 24th. The highest temperature in the sun was 80° (*not* by a black bulb in vacuo) on the 24th. The average daily temperature for the above-mentioned fortnight (mean of 50 years at Greenwich), is 36·3°, showing the prodigious excess of 11·35° above the mean this year.

As might be expected, the effect upon vegetation has been striking. On Ross Island, Killarney, horse-chestnut had opened, and several boughs in full leaf were gathered Jan. 22. On that date the following plants had been found in flower, the first-named three or four having been in bloom a fortnight:—

Ulex spinosa	Prunus spinosa (once)
Senecis vulgaris	Nepeta glechonea
Bellis perennis	Crocus (yellow)
Veronica hederofolia	Galanthus nivalis
Capsella bursa-pastoris	Potentilla fragariastrum
Viola tricolor	Lauristinus
Lamium intermedium	Laurel (coming in flower)
Leontodon taraxacum	Primula vulgaris (beginning of month)
Eranthus hyemalis	
Petasites vulgaris	Poa annua
Ranunculus ficaria	Veronica chamædrys
,, repens (once)	Cardamine hirsuta
Coryllus avellana	

No rain has been registered between the 15th and 25th. The mean force of wind has been only 1·7. During the height of the anticyclone (when for three days the barometer stood above 30° 7 in.), the sky was thickly covered with stradus cloud. Sunshine accompanied the reduction of pressure. On the 18th the barometer reached 30° 94 in. G. R. WYNNE, F.M.S.

XUM

Queries.

[257]—Nebulæ.—Are nebulæ external to our cluster? If so, what reasons are given for believing them to be?—A Derby Student. [Nebulæ are proved, I think, by the reasoning of Herbert Spencer and others, to belong to our own stellar system. I believe not a trace of aught external to our cluster has ever been seen with the telescope. But the reasoning is not readily given in a sentence. In my "Universe of Stars," it occupies two or three hundred pages, and requires a number of illustrated maps.—Ed.]

[258]—Drying Wild Flowers.—I am about to visit Egypt and Palestine, and wish to bring back some specimens of wild flowers. Will you kindly inform me how to dry them, so that they may retain their natural colour and form?—H. R. S.

[259]—Ventriloquism.—Could any reader of Knowledge kindly explain to me how ventriloquism is produced?—Erin.

[260]—Lightning.—There are two hills with an altitude of about 350 yards, and whose summits are about 3,000 yards apart. On the inner slope of one hill, and about half-way down, three cottages were built, and each of them was destroyed by lightning, separately, and in a period of seven years. An opinion of what is the cause of the lightning concentrating itself and making this particular spot its point of contact in preference to points of higher elevation will greatly oblige.—Secretary.

[261]—Commercial Tables.—As the Education Code does not require illegal or reputed "measures and weights" to be taught in public elementary schools, can you inform me if commercial tables (on cards or otherwise) of such as are only legal, or at any rate practically used in trade, are published, or what is taught in the London School Board Schools?—W. F.

[262]—Old Atlas.—Is the following work rare or valuable? "Atlas Novus sive Tabulæ Geographicæ totius orbis faciem partes Imperia Regna et Provincias exhibentes exactissima cura iuxta recentissimas observationes æri incisæ et venum expositæ à Matthæo Seutter sac: Cæs: Majest: Geogr: Augustæ Vindelicorum." It contains some sixty maps, fifty by Seutter, and about ten by Lotter, which are splendidly printed and coloured, and is of very large size. —S. P. Q. R.

[263]—Vegetable Food.—Will Mrs. Dr. Kingford kindly inform the writer where he will find guiding information to enable him with safety to enter on a course of vegetarianism? He should like for himself to test the truth of her statements.—Provost P.

[264]—Strata.—In travelling from London to Exeter (G.W.R.), what formations are passed through? I noted the following rocks on the way down, but do not know to what age, &c., they belong:—London to Reading, gravel; chalk nearly as far as Goring; then, through miles of grey clay to Didcot; then red clay, light-yellow and grey rock, to Corsham; layers of rock and red earth outside Bristol; limestone beyond Weston Junction; red soil opposite the Wellington monument; and slate at Exeter. Any information will greatly oblige—Carus.

[265]—Pigments.—Wanted a list of colours soluble in alcohol or wood naphtha; especially what blues and blacks are soluble; or name of books giving this information.—Arthur.

[266]—Sulphur Cast.—I should be obliged by information how a sulphur cast (which seems to give more perfect details than one in any other substance) can be made a sufficiently good conductor to electrotype upon. I have tried rubbing it over with plumbago, but it would not take the deposit of copper.—C. J. W.

[267]—Thoracic Integrity.—I have been taught to regard the chest as an air-tight cavity, any opening into which would cause speedy death. In "Science for All," vol. ii., p. 305, it is related that, through an opening in the chest, the heart has been handled. Have I been misled, or has some unauthenticated statement found its way into the publication named?—C. M.

[268]—Photography.—Can any person, through the medium of these columns, give me information concerning photography? 1, where to get the cheapest articles required for photography? 2, how to go about it? and 3, what are the chemicals required?—Anon.

The Magic Wheel.—If those of your readers who possess an induction coil and a small vacuum tube will revolve their magic wheel by the light of their "tube," they will find it has the same effect as the looking-glass, if a certain speed is maintained. The revolutions, of course, should = number of breaks at contact breaker ÷ slits in disc.—G. E. V.

Replies to Queries.

[195]—Quicksilver.—Your little note at the end of reply to query 195, p. 324, respecting a dose of small shot, reminds me of a custom here in Lincolnshire, which still prevails amongst the labouring class, of taking a few "shot corns" to cure "the rising of the lights." What this means I have never been able satisfactorily to discover. I once knew a well-to-do tradesman who frequently took a dose.—C. J. C.

[210]—The Iliad.—Newman's "Iliad" is much better than dry Bohn's.—Jaciebat.

[228]—Microphone.—Dry pile not at all suitable. The most simple galvanic pair far better; or a strip of carbon 1 in. × 3 in., and zinc the same size, separated by a pad of blotting-paper moistened with weak sulphuric acid would be strong enough, and would work as long as moist.—G. E. F.

[229]—Hair.—I do not believe there is a single authenticated instance of "a person's hair turning white instantaneously from fear, or other causes." On the other hand, it is well known that a person's hair has become white in a short time, such as a single night. Some years ago it was often stated, and as often contradicted, that the hair of one of our most eminent statesmen was the subject of this remarkable change. This case I can set at rest, for the gentleman to whom I refer told a friend of mine in this city (Manchester) that, when on a visit in Ireland, he went to bed one night with dark hair, and rose next morning with it exceptionally white. It is generally understood that this only takes place when the person is suffering from extreme mental anxiety, intense grief, or bodily suffering; but these causes were excluded from the case of the statesman to whom I refer. The medical man whom he consulted told him there was no cause for alarm, and he thought no more of the matter. A short time ago I heard him address an audience in this city, and I am of opinion that his hair has become a shade or two darker, and less snow-like in colour. I am not aware that the sudden change of colour in human hair has been scientifically explained.—Wm. Horsfall.

[229]—Hair.—The sudden change of the hair from dark to grey which sometimes happens has never been satisfactorily explained. It appears in some instances to be due to the development of air between and among the cells composing the air.—Quain's "Anatomy," vol. ii., page 226., Eighth edition. It is a fair explanation to say that the change is probably due to an impression upon the nerves of the scalp, in common with the rest of the skin, causing a contraction of the capillary blood-vessels, and a consequent with-holding of pigment.—Robert Macpherson.

[230]—Telescope.—The paint used for the inside of the telescope was common, dry, black paint, mixed with water, a quantity of thin flour-paste being added by way of size. Diaphragms are placed in the eye-piece tube; there are none, however, in the principal tube. —A. P. M.

[231]—Chemical Problem.—Let the required equation be

$$aCu + bHNO_3 = xCu(NO_3) + y_2H_2O + zNO.$$

Then the multiples of Cu on the two sides must be equal; *i.e.*,

$a = x$; so $b = 2y$; $b = 2x + z = 2a + z$; and $3b = 6x + y + 2 = 6a + \frac{b}{2} + z$

$= 6a + \frac{b}{2} + b - 2a = 4a + \frac{3b}{2}$: whence $b = \frac{8a}{3}$; $y = \frac{4a}{3}$; $z = \frac{2a}{3}$

—T. J. P.

[232]—Chemist.—"W. A. Fyson" should apply to the Registrar of the Pharmaceutical Society, 17, Bloomsbury-square, W.C., for a copy of "Regulations of the Board of Examiners" and "Hints to Students. Both would be sent on application with stamped envelope. The fees are:—Preliminary (as apprentice), £2. 2s.; minor (chemist and druggist), £3. 3s.; major (pharmaceutical chemist), £5. 5s. The two former are compulsory, the latter optional. Certificates of having spent three years with a duly qualified pharmacist, and of attaining the full age of twenty-one years, are demanded before the candidate can enter for the minor. There is at present no compulsory curriculum at a school of pharmacy, although such is the usual course, and costs from £15 to £150. A few, however, with "severe study," pass without such aid. The premiums for apprenticeship vary from nil, in heavy country businesses, to £200 in first-class town pharmacies; £100 being near the average in fair dispensing establishments. Before commencing pharmaceutical studies, the preliminary or classical examination must be passed. After this the spare time of two years may be well spent in studying with "Attfield's Manual of Chemistry"

(price 15s.); then, during the last year, "Bentley's Botany" (14s.), "Pereira: Materia Medica" (25s.), and "Fownes' Chemistry" (18s. 6d.). The least possible expense (exclusive of living and books) is £5s. 5s.; the least time, three years—both expense and time being generally very much exceeded. Capital required for business, from £500 to £2,000. At present the game is not worth the candle, but what the future of pharmacy in this country is, doth not yet appear.—PHARMACIST.

[233]—BIOLOGICAL.—John Hampson will find the relative brain capacity of the Neanderthal skull with man, with "illustrations," also the geological formation in which it was found, in Lyell's "Antiquity of Man." He will also see, by reference to Dr. Morton, Professor Huxley, and others, what is, indeed, very easy of demonstration, that the difference between the brain powers of the higher apes and the lowest savage is very much less than the difference between the brain powers of the lowest savage and the cultivated European.—F. SELBY.

[236]—THE POLAR SUN.—Neglecting the ellipticity of the earth, it takes the same time as to decrease in polar distance by its diameter (including '+') the effect of refraction, that is—

90° + ref. = 90° 34′ 54″
89° 27′ 50″ + ref. = 89° 56′ 33″

38′ 21″ at ·99″ per min. = 2,280 minutes.

and in 2,280′ the sun's movement along the horizon + his own motion (apparent, of course) = say 572°.—TRIA.

[236]—THE POLAR SUN.—To an observer at the North Pole, the rational horizon is coincident with the celestial equator; the sun will, therefore, rise above the polar horizon at the same instant as he crosses the equinoctial at the vernal equinox. At this epoch the change of declination (or angular distance from the equinoctial) is at the rate of 59·27″ per hour, and the apparent diameter of the sun's disc at the same epoch is 32′ 11″; hence the time occupied by the rising of the sun's disc is found by division to be 32·57 hours, or 1,954 minutes, and the arc of the horizon moved over during this time will be at the rate of 360 degrees per 24 hours, which is 488½ degrees. A more rigorous method of arriving at the above result (which is only approximate) is to calculate the exact instant of Greenwich time when the sun's *upper* limb is on the horizon, and then to repeat the calculation for the *lower* limb on the horizon. The difference of the two times is the exact interval required. Nothing, however, is to be gained by entering more minutely into such purely technical calculations. The above result is probably correct to a few seconds of time.—A. N. SOMERSCALES.

[247]—WARMTH AT NIGHT.—Unless J. M. J. proposes to confine himself entirely to the house, and unless he keeps his sitting-room at the same temperature as his bedroom, a fire all night would certainly be injurious. The advice, however, that can be given in this column will not be of much use to him. He should consult his medical adviser, who can make himself conversant with every symptom. Advice is best, as a matter of course, when it is based upon accurate knowledge.—ROBERT MACPHERSON.

[248]—LEPIDODENDRON.—To prevent the decay of fossil shells, &c.:—Steep them in a weak solution of gum-arabic for several days. All fossils taken from an exposed sea cliff of loose soil—as, for instance, the drift shells of Blackpool—must be soaked in fresh water for two months and then treated as above. The metallic nodules you mention are concretions of iron-pyrites, the so-called "Thunderbolts" of the Isle of Wight. No doubt the apparent casts of vegetable remains are due to the crystallization of this substance. It is almost useless to carry home any fossils, however fine, which contain a trace of this substance, for, though they may be as hard as steel when first obtained, they will, sooner or later, come to grief. If the "brick earth" of West Drayton be glacial clay, the chances of finding any fossils are very remote. To decide this question, look for ice marked boulders, such as that figured and described in KNOWLEDGE, p. 345. Be particularly careful to keep all fossils in a perfectly dry place; I have seen many valuable specimens completely spoiled by the neglect of this precaution.—J. H.

GOATS TO PROTECT SHEEP.—The farmers of Hunterdon and Somerset counties, New Jersey, use goats to protect their sheep from dogs. Two goats can drive away a dozen dogs, and two are about all each farmer puts in with his sheep. As soon as a dog enters the field at night, the goats attack him, and their butting propensities are too much for the canine, who soon finds himself rolling over and over. A few repetitions of this treatment causes the dog to quit the field, limping and yelling. Formerly, when a dog entered a sheep-field at night, the sheep would run wildly around and cry piteously. Since the goats have been used to guard them, they form in line behind the goats and seem to enjoy the fun. The idea of utilising goats in this way came from the West, where they are put in sheep-pens to drive away wolves.—*N. Y. Sun.*

Answers to Correspondents.

**** All communications for the Editor requiring early attention should reach the Office on or before the Saturday preceding the current issue of* KNOWLEDGE, *the increasing circulation of which compels us to go to press early in the week.*

HINTS TO CORRESPONDENTS.—*1. No questions asking for scientific information can be answered through the post. 2. Letters sent to the Editor for correspondents cannot be forwarded; nor can the names or addresses of correspondents be given in answer to private inquiries. 3. No queries or replies savouring of the nature of advertisements can be inserted. 4. Letters, queries, and replies are inserted, unless contrary to Rule 3, free of charge. 5. Correspondents should write on one side only of the paper, and put drawings on a separate leaf. 6. Each letter, query, or reply should have a title, and in replying to letters or queries, reference should be made to the number of letter or query, the page on which it appears, and its title.*

A. ARTHUR READE.—I should be glad to give my experience of the effects of smoking, but I smoke so little that I may practically be said to have no experience in the matter. I never smoke unless the presence of a great number of smokers renders it unpleasant not to. As for alcohol, when I work hard, which is most of the time, I find the less alcohol I take the greater my working energies. For eighteen months (some years ago) I took no alcohol, and my work never went more easily. At present, even when I work hardest, I do not go down to absolute abstinence; still, my working allowance is too small to make much difference one way or the other.—W. J. COLLINS. We quoted Dr. Carpenter's address because of its intrinsic merits, not as part of a discussion. For the discussion of a medical question you should go to medical journals.—J. A. MILES. Many thanks for the table; but fear there is no space. The algebraist can get any of the tabulated relations at once when he wants them, others would not look at the table. Will try to find room for problems 1 and 2, as they are general.—J. OFFORD. Many thanks. There may be delay in appearance of your interesting communications; but they will appear. The paper you write on quite suitable for printers.—H. P. COOPER. Thanks; will try to find space for new form of electrical accumulator.—G. E. SUTCLIFFE. Reference to the key, after sufficient attempts to solve problem, perhaps the best course; you should notice how the difficulties which had foiled you are mastered. The best promise of proficiency in your letter is your evident anxiety to become proficient. With a little practice you will probably succeed.—WM. DAVEY wants to know how he may soften animal hair without destroying it or injuring its colour; he would have been among the Queries if he had put his question in proper query form.—T. J. P. Thanks; but why not follow rule and put title of query? When we get such a reply as yours, we have to hunt up the query through back numbers to get the proper heading, and our work is heavy without this. It would be easy for you, with the query before you, to write its title.—J. MCGRIGOR ALLAN. No space for articles or any but very concise letters about mutilation of animals. Section V. on other subject later if can find room.—S. S. S. S. wants best book of Mechanical Philosophy for C.S. examination. Both the French writers you name good popularisers of science, but without mathematical knowledge, so that they are only to be trusted when quoting the opinions of others. Lardner's "Museum" partly obsolete, but in part still trustworthy. Impossible to answer more definitely in space at our command. Magnetism cannot be interrupted, as electricity, by non-conducting bodies. We use your words, but they are inappropriate.—W. P. WANTAGE. Already answered.—W. H. SAND. A. R. MOLLISON. Answered.—NAMELESS. 49, Victoria-road. Solution correct.—R. G., J. N. P., A LEARNER, PHRENSY, EQUES, ROB. E. ALISON, B. G. MORRIS, and others. Dear sirs, how can we find time to work out such sums as you send? If we could hire a calculating boy, who could tell us in 2 sec. how long a wire $\frac{1}{30}$th of an inch in diameter could be made out of a cubic foot of brass, or in 3 sec. how often a cart-wheel 3 feet in diameter would turn if rolled a distance equal to the sun's from the earth, &c., we would tell you all about these things. *One* of you has taken an appropriate name.—CHARLES BURNS, noting that the Goat and Compasses = God encompasseth us, desires to have corresponding equations for the Pig and Whistle, the Magpie and Stump, and the Bear and Ragged Staff.—THOS. SIDDALL. Will insert queries if you will make them suitable.—B. M., F.R.C.S. Thanks, suggestions noted. — A. M. SOMERSCALES. Thanks, will wait till C. T. B. explains what was really meant. Of course, oblique is less than full illumination. In case of still water, the brightness you mention is due to reflection, not to surface illumination. But this was not C. T. B.'s difficulty.—A. J. P. Know of only one kind of aneroid, in which the box is completely exhausted of air, the elasticity of covering balancing the atmospheric pressure. — A. ORMSBY. Would give your problem (Napoleon's) for solution: but it is necessary to reserve mathematical column for other matter. You will find no difficulty in solving it if you go to work as follows:—Pay no

attention to the equilateral triangles, which lead you away from true solution. Note only that the centres of these are centres of arcs on triangle's sides containing each an angle of 60 degrees. Through angle A of triangle draw, to meet arcs on AB, AC, line PAQ parallel to line joining centres of these arcs. PQ is the maximum straight line which can be so drawn. Let PB and QC produced meet in R. PQR is the maximum equilateral triangle which can be described about ABC. Hence PR and QR are parallel to lines joining centres of the other pairs of arcs (for otherwise a larger equilateral triangle could be drawn, and one side of this would be a longer chord than PQ, which is impossible). Hence, the triangle formed by joining centres of these circular arcs has its sides parallel to sides of triangle PQR, and is therefore equilateral. —Oswald Dawson. Thanks. Come in early with definitions, and you will be very welcome. I quite agree with you that at the beginning of any discussion sound definitions are very important. Yes, Professors King and Rowney were the opponents of Eozöon Canadense. 'Twas they of whom the poet (that good fellow Brough) wrote in 1869:—

And through the lists a cry has flown—
A daring challenge for a fight—
"Eozöon, be it known,
Has structure like the nummulite;"
And on brave Dawson's gauntlet warm
Is dimly traced in mystic line,
"Outline of film asbestiform,
And chambers all acervuline."
But hark! a loud, defiant shout
Resounds from Connaught's distant strand:
The King of Galway has set out,
All mail'd in ophite, pen in hand;
And to the field he hies him straight,
With gentle Rowney, knight renown'd,
Whose prowess none will underrate
On Chemistry's broad fighting-ground, &c.

—M. M. The size of the moon's image formed at focus of object-glass having 42 inches focal length, will be about 37·75 inches, as you can readily prove by directing the telescope to moon, removing eye-piece (and, if necessary, eye-tube also), and receiving the image on a piece of card or paper. But the magnifying power depends on the eye-piece, and you cannot say the image will have an apparent diameter of so many *inches*, but subtending such and such an angle. With a power of 100, for example, the moon's apparent diameter would subtend an angle of about 3,100′, or nearly 52°.—Eloa requires information as to management of gold fish in glass globe, average duration of their lives, &c. Captive balloons (this refers to a different subject, let me explain) might certainly be sent up with minimum thermometers, to determine temperature of upper regions of air.—Simplex. Quite so: but now if you would compare some of the symbols. Nearly every stenographer knows Pitman's; I use it myself, though not for reporting. Could you not give us ocular demonstration of the superiority of Bell's system.—Sir T. W. Letter sent at once to publishers.—C. Lloyd E. Pardon me, but I was thinking of another correspondent. Your evidence about the poker is balanced by an equally wide experience the other way. But why should I be prejudiced against the poker-across-fire theory? If a theory so remarkable could be established by the rough kind of evidence you adduce, it would be a delightful subject for Knowledge. As it is, it only illustrates what men *can* believe, and Herbert Spencer has already used it in that way.—R. C. Your difficulty is a natural one. Yet notice that every part of an ellipse is concave towards centre, or towards either focus, despite the increase and diminution of mere distance. If you draw the moon's path to scale, you will see that it is concave towards the sun all the time. Describe two concentric circles rather less than a quarter of an inch apart (·24 inch), and having radii of 92 and 92¼ inches respectively, and divide their circuit into twenty-five equal parts. Then the moon's path would be represented by a curve passing from the outermost to the innermost, and then to the outermost again, and so on, the successive contacts occurring at the successive divisions along the outer and inner circles alternately.—Tita. Will try to find space shortly both for letter and extract; meantime, let me note that you seem to me to be quite right. There seems to be as much scientific accuracy in the account as in the blind man's statement that red was like the sound of a trumpet, or in the association most of us have had as children (and, perhaps, still have) between the days of the week and particular colours. For instance, with me Sunday is yellow, Monday rich red, Tuesday olive green, Wednesday bright green, Thursday dark grey, Friday orange, and Saturday light grey. The months have also their colours.—J. Rae. If you had chanced to read my accounts of Arctic travel, you would know I did not need to be informed of what you kindly tell me. It will be time enough when the Pole is reached to learn how long the explorers will have to stay there. You see, I give you another opportunity for contradiction, which seems your strong suit; but you should try to make out what you are contradicting.—B. We have not used an instrument having a vernier divided as you describe; but it seems obvious that it would serve to divide to one-half the arc to which the older form of vernier will divide. Thus, when you have the vernier divided into 60ths of 59′, you take the division nearest to one on the limb, and so get the reading true to a second of arc. Now with the vernier divided into 60ths of 119′, you can either take the division nearest to one on the limb, or noting that two divisions on the vernier are appreciably equidistant from the divisions (alternate) on the limb, you regard the bisection of the space between those two divisions on the vernier as coincident with the division midway between the two on the limb. You read this just as easily as you would if the bisection were marked on the vernier. Hence it is as though the vernier were divided into 120ths of 119′, enabling you to read to half seconds of arc, instead of to seconds only.—Etaph. No truth in the report, but thanks.—A Subscriber. Odds in favour, as you say. It seemed too obvious to need correcting. East and west in star maps right. You look down at earth, up at sky. Hence the difference. Evidence about pink tinge of ashes, in fire gone out in sun would be interesting.—Why? oh, why will not "A Subscriber" follow rule, and give number and page of letters? —Farmer Will. Your queries will not go under any heading we can invent. If you do not think them worth heading, can you think them worth inserting? You say, in the midst of your queries, that if the doctrine of evolution is true, the doctrine of fate is also true. What is the doctrine of fate? Why not say, as you may with equal reason, that supposing trees and animals really grow, and are not changed from state to state by special acts of creation or change, the doctrine of fate must be accepted?—T. A. "I do not know how it is, but at present I like my hypothesis the best, it seems to my poor judgment the nearest the truth." Most of us feel that way. But, as you very truly say, Who can thoroughly understand these things? If we had not so much to insert about things we *can* to some degree understand, we might take up these inconceivables.—Hafed was dazed three days "by Magnetism? Astroism? Divine Effluence?" We do not know; but infer, it was on one of those days that he sent us advertisement of "The Magnetic Pilgrim" who "tarries top of Bunyan Street."—John T. Page. The practice of collecting autographs is not childish, far from it: nor is a toothache a joy for ever, very much the reverse.—Hon. Sec., Civil, and M. Engineer's Society. Mr. Love's paper was marked for insertion, but crowded out by press of matter requiring more immediate attention,—and more concisely written.—J. Kirkman, M.A. Questions now answered. But would it not have been an inaccuracy to have, in first act of Harold, a reference to "Arcturus dancing so brightly, almost through the nucleus of Donati's comet in 1858?" not that Arcturus danced, or seemed to dance, at that time—to my eyes any way. — T. J. H. Matter too complex to be adequately treated in short notes, and no room for long ones.—Hygeia. Fear the ill-effects of tight-lacing and high heels are as well known to the tight-lacers and high-heelers as to the rest of the world. Articles on the subject would be thrown away on those, and are not needed by these.—Alpha. There is no reason for supposing that there has been, within the last few centuries, any perceptible change in our northern climate; but, if there had been, the displacement of the Pole Star by precession has nothing to do with it. The inclination of the earth's axis to the plane of her path does not vary in any such way as to affect climate.—Anti-Kreophagist. I do not think any flesh-eaters so ignorant as not to know of the wide range of food materials open to vegetarians. I am not myself a vegetarian, but at a time (three years ago) when I did a great deal of mental and bodily work (rowing every morning two hours at my hardest, and often in heavy rain) I used frequently, for several days in succession, to take no food but fruits and vegetables—not on principle, but from sheer carelessness: and I cannot say I ever felt the least failing of strength. I never had better health. My tastes, however, are of the carnivorous kind, or rather, they are for our customary mixed diet. An Abernethy biscuit and a bunch of grapes will serve me for a dinner, on occasion, very well; but I do not "hanker" for such food. I mention this, not as of any interest in itself, but to show that if fruit and vegetables agreed with me so well, it was not because I liked them (so that the evidence in their favour is so much the stronger).—A. H. E. Nos. 2 and 3 are not out of print. They might be picked up, perhaps, after a little inquiry; but I know of no place where they could be obtained. A few copies remain of Part I., in which are these numbers, and a limited number have been kept for our volumes. It would be useless to reprint them, as many others of the earlier numbers are nearly sold out too; so that if reprints were ordered at all, at least eight numbers would have to be re-

printed, which, of course, cannot be thought of.—C. C. C. The theory you advance was originally suggested by one Isaac Newton; but calculation has since shown that the phenomena of comets' tails are irreconcilable therewith. We shall come again to comets by and by, if correspondents will give us leave.—A. J. Martin and C. J. C. It would indeed be interesting to astronomers if the sun's elevation varied in the way described by "A Resident in Glengloy, Upper Lochaber, N.B." But too good a watch is kept on the sun at Greenwich, Paris, Washington, &c., for him to play such tricks without our knowing it. *If* the sun really shone over a hill this year, at a time of year when formerly he did not top the hill, the hill has changed, or the level of the ground where the house stood from which the observation was made. — R. H. Thanks. Solutions neat, but no space.—G. S. E. How if he declines to be "relegated?"—Hy. Creagh—C. Sorry, but in fairness to other squarers must regard all magic squares as now done with.—Microcrith. There may be some slight difference in the friction, but otherwise can be none.—W. G. Parriss. When a gas-flame is blown, the already ignited gas is driven away from that which in the ordinary course would be ignited next; thus this gas remains unignited, and the other part burns out. The wind or breath does not cause combustion to cease; it prevents combustion. Combustion in a steadily-burning flame is beginning and ceasing all the time.—W. G. Woolcombe. I *cannot* reconcile observed facts with the postulated law, "a force acting in a direction at right angles to direction of motion of a body has no effect in altering the direction of motion." That law will be postulated a long while before it is established. Write "no effect in altering the velocity of motion," and you have less trouble. "That's how the error has arisen." Your geological difficulty suggests that those subjects do not greatly attract you; but with determination it will vanish—Experto Crede. Do not know of any one who sells very extensive series of rocks; but think a letter addressed to Prof. Tennant, of King's College, would bring you information on the subject.—J. W. C. Loomis's book gives all necessary information for projecting an eclipse from the data in *Nautical Almanack*. Johnson's does not. Believe Bogue publisher of latter work.—W. N. W. says second volume of Allen's work on "Commercial Organic Analysis" is now issued; price, 10s. 6d.—Edm. Hunt. We are content to wait. Do not think the construction we gave can possibly be misunderstood.—Zares. Galileo, no; Newton did, though. You confound inertia and momentum. Every force, however small, affects the inertia, but only an equal momentum can match the momentum of a moving mass. I not only "seem to imagine," I *know* that I am dealing with a well-known and well-understood subject. You might with advantage study some good text-book of dynamics; or, for the history of the matter, look up Whewell's "History of the Inductive Sciences," Vol. II., pp. 45-52. Thanks for hints how to manage correspondence, but we see the matter from another point of view.—J. H. M. Such mesmeric experiments would do something to establish the claims of phrenology, if one were sure the subject knew nothing about the bumps. Your "young man of the name of Walker" (H.?) may have known a good deal.—C. T. W. The "equation of time" varies slightly from year to year, as the position of the earth's perihelion changes. But very slightly. The equation of your old dial would, if exact, indicate roughly the time when dial was made.—W. C. My "sub" and I have quite enough to do without the classification you suggest. Now, about your question: I did not mean to snub you, as you say I did; when you asked how the star-maps were to be used in the dark, it seemed an all-sufficient reply to say they were not meant to be so used.—W. F. Denning. I also should have preferred publishing your letter. But it could not be, with space at command.—J. Harbord. I cannot, at this moment, recall any earlier references to Mephistopheles in English literature than those in Marlowe's "Faustus."

Letters Received.

Edina, M. K. Fothergill, J. Harloch, G. E. V., Marplot, Pertinent (read it Pertneus), Carus, W. C., G. C. E., J. Harvey, X—Z, Weary, K. Hardy, M. Brant, X. L., Jansen, A. Martins, Halloween, Cardinal Point, J. Easterbrook, L. Murrill, J. S. T., Curious, J. Fordinham, M., N. Eastman, T. Elliott, J. Pearsall, Manchester, M. Pewtress, A Woman, Philalethes, M. B. Q., R. B., Jas. Atherill, F. Brown, J. T. S-m, Post-Prandial (so we should imagine), C. Carteret, S. Y. Ellis, Porter, A Constant Reader, R. S. S., M. Peewitt, Jas. C. Christie (try Cockle's).

Pond's Extract is a certain cure for Rheumatism and Gout.
Pond's Extract is a certain cure for Hæmorrhoids.
Pond's Extract is a certain cure for Neuralgic pains.
Pond's Extract will heal Burns and Wounds.
Pond's Extract will cure Sprains and Bruises.
Sold by all Chemists. Get the genuine. [Advt.

Special Notice.

Exchange Column.—In No. 18 we shall open an Exchange Column, similar to that which has for several years formed a feature in our excellent contemporary, the *English Mechanic*. The charge for Exchange notices will be 3d. for the first twenty-four words, and 3d. for every succeeding eight words.

Sixpenny Sale Column.—We shall also open a Sixpenny Sale Column, in which advertisements will be inserted at the rate of 6d. for the first sixteen words, and 6d. for every succeeding eight words.

Enlarged Numbers.—We propose, from henceforth, to extend Knowledge to 32 pp. twice, at least, in each month; and we hope that our growing circulation will enable us to enlarge Knowledge permanently to 32 pp. weekly. If all our readers would help in extending our circulation, which some (whom we hereby warmly thank) have done so effectually, we should very soon adopt a weekly 32 pp. number.

Notes on Art and Science.

Stove Heat.—Those of your readers who have seen Mr. Williams's article on the "Air of Stove-heated Rooms," and who find stove-heating both comfortable and convenient, may be glad to know that the "Crown Jewel Base Burning" Stove does not diffuse its heat "through red-hot iron;" it cannot injure, but tends greatly to promote health. I have used one for years.—R. F.

Inhaling Sulphuretted Hydrogen.—I was surprised to read in No. 14, page 293, the remarks of Mr. Mattieu Williams on the inhalation of sulphuretted hydrogen. I was rather careless about the inhalation of this gas until, after suffering six successive and unaccountable attacks of illness, I traced them to this cause. The attacks consisted of violent pains in the stomach, and in each case they occurred about three days after the inhalation of the gas. I may mention that, finally, in order to make quite sure in the matter, I purposely inhaled a small quantity of the gas, with the result of a slight attack of the pains after the usual interval. It appears to me that it is a gas which produces different effects on various people. In Roscoe and Schorlemmer's new work it is described as "a powerful poison, producing insensibility and asphyxia." This may be true, but it is not the effect it had on me —nor, it appears, on Mr. Williams.—H_2S.

Science Teaching.—At the annual general meeting of the Teachers' Training and Registration Society, and of the Bishopsgate Training College, the other day, Prof. Goldwin Smith took laudable advantage of the opportunity to impress on those present what science teaching really means. "In respect of the teaching of science," he said, "he had constantly brought before him the wide gulf fixed between the two different kinds of what persons call knowledge. The one was a mere learning to repeat a verbal proposition, and the other was knowing the subject at first hand—a knowledge based upon a knowledge of the facts. That which they had constantly to contend against in the teaching of science in this country was that teachers had no conception of that distinction, for they thought it quite sufficient to be able to repeat a number of scientific propositions and to get their pupils to repeat them as accurately as they themselves did. If he might offer one suggestion to the governing body of the college, it was that so far as they taught science at all they should aim at giving real and practical scientific instruction; that it should be confined to those things about which there was no dispute; and that the teacher should be instructed that his business in teaching was to convey clear and vivid impressions of the body of facts upon which the conclusions drawn from those facts were based."

Biting.—A Serpent, if surprised suddenly, or brought to bay at close quarters, may be too terror-stricken to attempt flight; then it *bites*, following a curious general rule which seems to obtain throughout nearly the whole animal world, from a passionate child downward, no matter what the natural weapons of offence may be. Young *Felidæ* will keep their talons sheathed until they have exerted all possible force with their soft milk-teeth, and a lizard will seize the hand which restrains it with its insignificant little jaws, when its tail or claws might inflict far more injury. The *Boidæ* never use their constrictive powers in self-defence (unless they are gripped), and it seems probable that if a venomous snake's fangs lay in its tail, it would use its teeth *first* when attacked before bringing them into play. Indeed, it must be remembered that very few animals are provided with exclusively defensive weapons, and that the python's enormous strength in constriction, the viper's poison apparatus, the lion's teeth and claws, and the electric discharge of the gymnotus are given them primarily for the purpose of securing their food.—Arthur Stradling, in *Nature*.

XUM

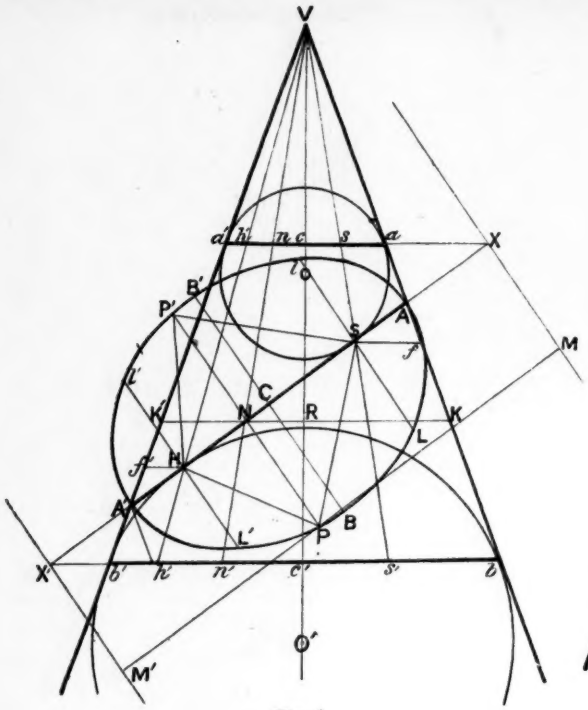


Fig 1.

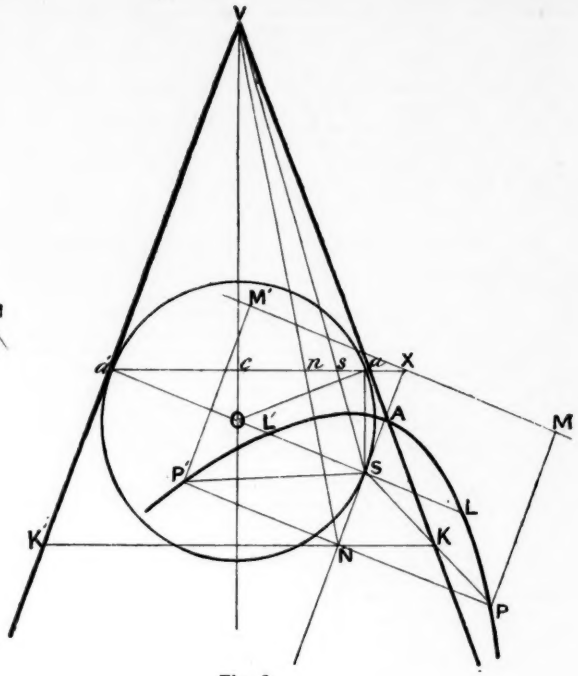


Fig. 2.

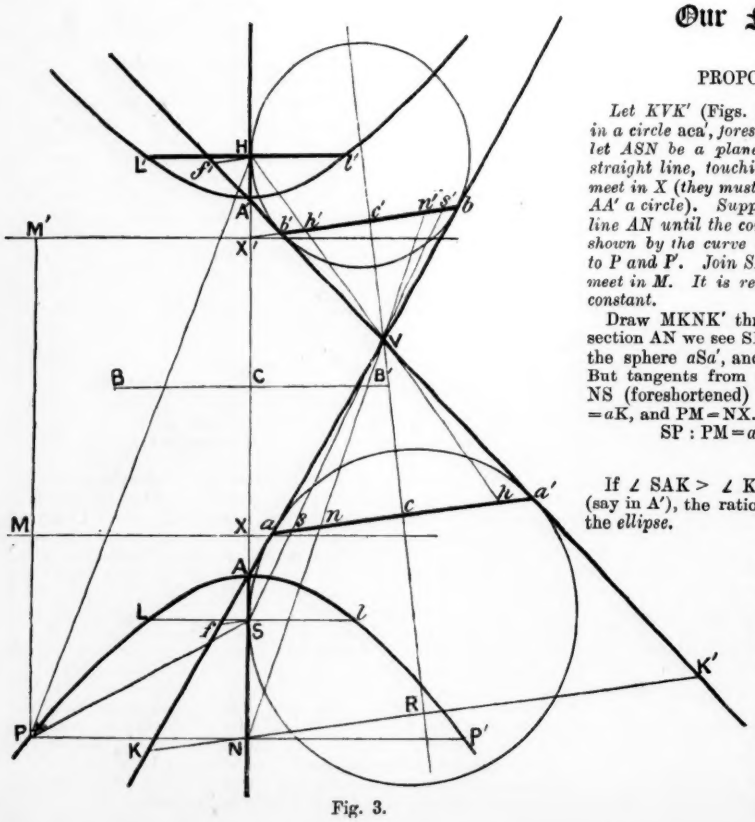


Fig. 3.

Our Mathematical Column.

PROPOSITION IN CONIC SECTIONS.

Let KVK' (Figs. 1, 2, 3) *be a cone, touched by the sphere* a*Sa' in a circle* aca', *foreshortened into a straight line in the fig.; and let ASN be a plane section of the cone, also foreshortened into a straight line, touching the sphere in S. Let* a'a *and NA produced meet in X (they must meet unless AN is parallel to* aa' *or the section AA' a circle). Suppose the section AN rotated around the straight line AN until the conic section occupies the plane of the paper, as shown by the curve PAP', the points which were at N being brought to P and P'. Join SP, draw PM parallel to NX, XM perp. to NX, to meet in M. It is required to show that the ratio of SP to PM is constant.*

Draw MKNK' through N parallel to *a'a*. Now, in the conic section AN we see SP (foreshortened) as NS, a tangent from N to the sphere *a*S*a'*, and N*n* is another tangent to the same sphere. But tangents from the same point to a sphere are equal. Hence NS (foreshortened) or SP = N*n* (foreshortened), which obviously = *a*K, and PM = NX. Hence

SP : PM = *a*K : NX = *a*A : AX, a constant ratio. Q.E.D.

If ∠ SAK > ∠ KVK', fig. 1, so that AN produced cuts VK' (say in A'), the ratio *a*A : AX is less than unity, and the section is the *ellipse*.

If ∠ SAK = ∠ KVK', fig. 2, so that AN is parallel to VK', the ratio *a*A : AX is unity, and the section is the *parabola*.

If ∠ SAK < ∠ KVK', fig. 3, so that NA produced cuts K'V produced (say in A'), the ratio *a*A : AX is greater than unity, and the curve is the *hyperbola*.

In the cases of the ellipse and hyperbola, we can take another sphere *b*H*b'* touching the cone circularly and the plane of section in H. For the ellipse, the second sphere touches the cone on the same side as the other sphere, and the plane of section on the other

side; for the hyperbola, the second sphere touches the cone on the other side and the plane of section on the same side.

The reader will find no difficulty in extending the proof to the lines HP, PM′, drawn from a point P on the curve to the other focus H and perpendicular to the other directrix X′M′. The construction is given for each case.

Note also that the relations HP + SP = AA′ for the ellipse, and HP − SP = AA′ for the hyperbola follow at once.

For, rotating the curves back to the foreshortened view, we have

SP foreshortened into tang. NS = tang. Nn = aK

HP foreshortened into tang. NH = tang. Nn' = bK

Wherefore HP + SP = ab in case of ellipse (Fig. 1)

and HP − SP = ab in case of hyperbola (Fig. 3).

—EDITOR.

The geometrical student will find a good deal more that is worth studying in the relations here indicated. We have added several lines (latus rectum, minor axis, &c.) to the figures for this purpose.

MATHEMATICAL QUERIES.

[37]—Given any two lines meeting in a point, and some point out of the lines; required to draw from this point to the str. lines two equal str. lines which include a given angle.—AMICUS MATHEMATICÆ.

[38]—ROLLING DISC.—Given the radius, weight, velocity, and angle of inclination sideways from the vertical of a circular disc rolling freely on a level place; find the radius of its track.—F. W. F.

---

[31]— $x^4 + 4x^3 = 27$

put $x = 3y$, then $3y^4 + 4y^3 = 1$

and $y = \frac{1}{z}$, then $3 + 4z = z^4$

Make a perfect square on each side—

(a) $z^4 + 2pz^2 + p^2 = 2pz^2 + 4z + p^2 + 3$

The right hand side will be a perfect square if—

$$4 = 2p(p^2 + 3)$$

i.e., if $p^3 + 3p = 2$

put $p = v - \frac{1}{v}$, then $p^3 = v^3 - \frac{1}{v^3} - 3p$

$$\therefore v^3 - \frac{1}{v^3} = 2$$

$$v^6 - 2v^3 = 1$$

$$\therefore v^3 = 1 \pm \sqrt{2}$$

taking the upper sign $v^3 = \sqrt{2} + 1$

and $\frac{1}{v^3} = \sqrt{2} - 1$

and $p^3 = \sqrt[3]{\sqrt{2}+1} - \sqrt[3]{\sqrt{2}-1}$

Let p have this value, then, from equation (a)—

$$z^2 + p = \pm\sqrt{2}p\left(z + \frac{1}{p}\right)$$

A quadratic with two roots corresponding to each sign, thus giving four values for z, and, therefore, four values for x ($x = \frac{3}{z}$, as might have been anticipated.—W. G.

[EQUATION, p. 328, No. 15].—"W. B." points out that in our solution of equations

$$x^2 = \frac{39}{y} - \frac{14}{x} \text{ and } y^2 = \frac{42}{x} - \frac{13}{y}$$

after getting $(x+y)^3 = 216$ by addition, we might have got by subtraction $(x-y)^3 = 8$. It is obviously the simpler course.—ED.

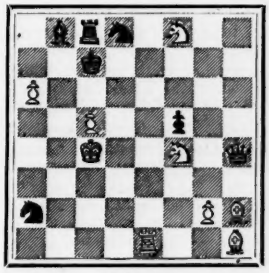
22*b*.—"Yarletonian," F. J. Butt, and others solve this equation; it needs only transposing, squaring, and simplifying, then squaring again and simplifying.

[Mr. McGowan's solution to 25, p. 307, to hand, correcting obvious blunders (20 for 120, and £$\frac{6}{5}$ for £$\frac{7}{6}$). It shall appear in our next. —ED.]

MESSRS. J. & A. CHURCHILL have recently published two interesting tables; one, showing the average weights of the human body and brain, and of several of the internal organs at eighteen periods of life in both sexes; the other showing the same (at decennial periods of life) in the insane, the forms of insanity being specified.

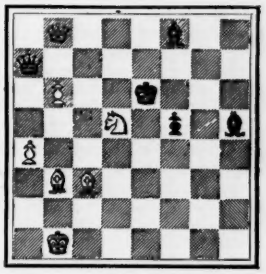
Our Chess Column.

No. 21.
By I. G.
BLACK.



WHITE.
White to play and mate in two moves.

No. 22.
By W. Thurman.
BLACK.



WHITE.
White to play and mate in two moves.

SOLUTIONS.

PROBLEM No. 14, p. 282.

1. B. to R.4.	1. K. takes Kt.
2. B. to Kt.3. mate.	

If P. to K. 5, then Q. takes P. mate. If P. to Q.3; Q.Kt. to B.7. mate. If P. to B.3.′ K.Kt. to B.7. mate. Finally, if P. to B.4. then Q. to Kt.8. mate.

PROBLEM No. 15, p. 282.

1. Q. to Q.6.	1. K. to K.6.
2. R. to Kt.3.ch.	2. B. takes R. mate.

If K. to B.6. then R. to B.3.ch.

PROBLEM No. 16, p. 308.

1. Kt. takes P.	1. K. to K.5, or a, b, c.
2. Q. to K.6.ch.	2. K. to Q.6, or B.6.

Kt. mates accordingly either on Q.Kt.4. or K.R.4.

(a) If 1. K. to Kt.7., 2. Q. to K.2.ch., 2. K. to R.6., 3. Kt. to B.4. mate, or 2. K. to Kt.8., 3. Q. to B.2. mate.

(b) If 1. K. to Kt.5., 2. Q. to Kt.6.ch., 2. K. to B.6., 3. Kt. to Q.4. mate, or 2. K. to R.6., 3. Q. to Kt.3. mate.

(c) If 1. B. to Kt.7., 2. Q. to Q.B.4. anything, 3. Kt. to R.4. mate.

ANSWERS TO CORRESPONDENTS.

*** *Please address Chess-Editor.*

Edward Sargent.—Nos. 18 and 19. If 1. Q. takes B.P., then 1. Q. to Q.R.sq.

R. S. Standen.—Solution of No. 15 correct.

C. H. F.—Solution of No. 17 correct.

H. A. L. S.—Solution of No. 17 correct.

J. P.—Remove Pawn on Black Q.R.2.

F. H. Jones.—Solutions correct.

Received offers to play by correspondence from—

M. J. Harding	A. C. Skinner
H. C. Angell	J. N. Siclebotham
E. A. Dillon	Edw. P. Westlake
F. H. Jones	D. Cudmore.

We have paired them in the order named above.

It is necessary the first players should play White. Two games may be carried on simultaneously, each player having the move. Answers should be sent next day after receipt of move, at latest. To avoid mistakes, the last move should always be repeated. For example:—12. $\frac{\text{P. to B.3.}}{\text{Q. to R.3.}}$ 13. $\frac{\text{P. to K.5.}}{\text{——}}$ In case of any misunderstanding arising, players may refer to us.

A SOCIETY to be called the North Middlesex Natural History Association has recently been established. Address, 26, Ingleby-road, Grove-road, Holloway, N. Its objects are the formation of a Natural History Museum and Library of reference and circulation; also the diffusion of natural history knowledge by means of lectures, papers, &c., and (in the summer) field excursions.

XUM

Our Whist Column.

By "Five of Clubs."

Dear "Five,"—The enclosed letter from our esteemed Whist correspondent, "Mogul," just received. After what I have told you about demands on space, you will see that it is quite impossible to find room for it (it would take more than a column). But it is not quite fair to answer a letter which has not appeared. I should be glad if you could write a short note, putting things right, without unfairness to our correspondent.—Yours faithfully,

Editor.

Dear Editor,—(1.) "Mogul" is right in regarding as "proven" my approval of *Z*'s play from strength in the first round of trumps (game No. 13). There was little chance of *Y* utilising the information; but it was better, I think, to give it. I hasten to correct impression, which he thinks readers might entertain, that dealer should *always* give information in this way. (2.) "Mogul" is in doubt how far I think the principle of playing a straightforward game should be carried, saying that apparently I admit of no exception but in the "closing rounds." That was rather an illustration than an exception. I may say that I do not go farther than that great whist-master, Clay; scarce so far. Clay's abhorrence of false cards was, I think, *tant soit peu* exaggerated. Clay, Cavendish, and Pole are all pretty much at one, however. (3.) When I speak of modern scientific whist, I do not mean that the older method was unscientific, but (as the grammar of the phrase implies) I distinguish the modern from the older scientific games. Rules have come into vogue now which were not formerly adopted; and whether they are good or bad, running counter to them means more than declining to give partner information; it means deceiving him. (4.) As to the game in No. 13, I gave it as actually played, faults included. "Mogul," in his published letter, pointed out objections to *Y*'s play, and I showed *then*, what seemed to me unnecessary before, how *Y* could tell that *Z* (i) must have five Clubs, and (ii) must know that he, *Y*, had four. "The length of my explanation is," Mogul says, "its condemnation." I am disposed to agree with him. All that is there explained at length should have been obvious: but "Mogul" did not seem to find it so. I agree with "Mogul" that *Z* should have led the Queen instead of the King; (as you know, I am not in this harder on *Z* than *Z* would think fair). 5. With all that "Mogul" says in his concluding paragraph I thoroughly agree, except, of course, in his persistent mistake that I am of a contrary opinion. If you will allow me I will quote what I take to be most excellent in this part of "Mogul's" letter. [We prefer not; "Mogul" would probably not think it fair to quote the excellent rules he gives without those passages in which he implies that "Five of Clubs" teaches the opposite; for when these passages are omitted, "Mogul" seems to teach precisely what "Five of Clubs" has been teaching. — Ed.] There is only one small addition I would make to his rule, "When strong, tell your partner; when weak, don't tell your adversaries," viz., this, even when weak, do not unnecessarily *deceive* your partner,—Yours truly,

Five of Clubs.

Play Second Hand.

There are few points which distinguish more thoroughly the good from the inferior whist player, than the play second hand. We are not, of course, referring to players so inexperienced as to know no other rule than "second hand play low." Nor are the rules for play second hand, at least in the opening rounds of a game, less definite than those for leading. But somehow it happens that many players who very seldom lead unwisely, who know well when to play highest and when to finesse third in hand, and when it is essential to success to win partner's trick fourth hand, are apt to trust, second hand, to chances which are demonstrably against them. Given, for instance, an original lead of a small card (plain suit), second player with Queen and a small one (and no special reason for risking something to get a lead), how often do we see the Queen played, though it is known that, in the greater number of cases, the card is thus thrown away. Of course, the play often steals a trick. Perhaps in five cases out of eleven it may do so, but it is bad, because in a greater number of cases it fails; and in every case it suggests for a while to partner that you held either the Queen alone, or King, Queen, and a small one. So in other cases which might be cited.

The rules for play second hand are in reality sufficiently simple, though here, as in the case of the lead, they seem multitudinous.

We note, first, that in general a low card is to be played second hand; for, in the first place, the suit is presumably your adversaries', and it is well to keep the commanding cards of their suit; and, in the second place, your partner lies at an advantage over third player, who ordinarily must play his highest, lest the trick should fall an easy prey to your partner. By playing high second hand you waste a good card, whether third hand takes the trick or your partner; you are rather worse off, too, if, though you take the trick, partner could have won it had you left it to him; for when the suit is returned, the lead will be through your partner's strength to your hand, weakened by the loss of its best card in the suit. You only gain if it so chances that neither third hand nor your partner has a better card; and it is unwise to play for only one among several chances.

Yet, still supposing the suit your adversaries', and that you have originally not more than three cards, it may still happen that a high card should be played. Thus, if you have Ace, King, one or more small ones; King, Queen, and one or more small ones; Queen, Knave, and *one* small one; Knave, ten, and *one* small one; or ten, nine, and *one* small one; play the lowest of the sequence. In the first case, you win the trick and still have the commanding card of the suit; in the others, if you do not win the trick, you avoid the risk of its being taken with a low card by third in hand, or your partner compelled to play a very high card.

Again, if a high card is led, and you hold a higher card and one or two small ones, it is generally best to cover. If third in hand take the trick, two good cards have fallen from the enemy to make one trick.

We leave to another occasion, however, the discussion of the play second hand in detail. We shall endeavour (though the task is not so easy as in the case of the lead) to reduce the play to system, instead of presenting some forty or fifty rules, as has usually been done.

We propose next week to give a game made up from the account given in Clay's "Short Whist," (see p. 176) of a case in which evil results followed from unwise persistence in forward play.

Maxim.—The best whist-player is he who plays the game in the simplest and most intelligible way.—*Clay*.

G. Thompson.—Whist problem correctly solved in your second letter. *B* played according to custom in such cases. Cavendish (p. 50 of latest edition) and others touch on the question whether it is well to lead from a long suit headed by Ace, Queen, and agree that it pays better in the long run to do so than to wait for the chance of being led up to. There is a good chance either of drawing the King, or, if second player has it, of partner winning the first trick. By waiting in such a case, you deceive your partner as to the chief constituent of your hand.

Problem I.—"Mogul" and "Vacuol" point out that this problem from the "Westminster Papers" is unsound, as *Z* may have Heart King. The objection seems valid, as certainly with King, Knave, ten, three, second hand, ten would be the right card to play. As third player holds only one Heart, the nine, there is a somewhat greater probability that *Z* is strong in the suit, than that he is weak, although it is *A's* long suit. The writer in the "Westminster Papers" may have had some reason for considering that *Z* cannot hold the King; but we can detect none, certainly none which would occur to *B* in ordinary play. "Mogul" adds that *Y* might have been signalling for trumps holding Knave, two, for aught *B* can know. This, however, appears to us incorrect. Playing Knave second hand from Knave, two, would not be signalling for trumps, but an attempt to take the trick. Clay, in his chapter on the signal, discusses this point, and, as it seems to us, his opinion that there would be no signal is correct.—Five of Clubs.

NOTICES.

The Publishers beg to announce that in future Monthly Parts of Knowledge will be issued. The following can now be had:—

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